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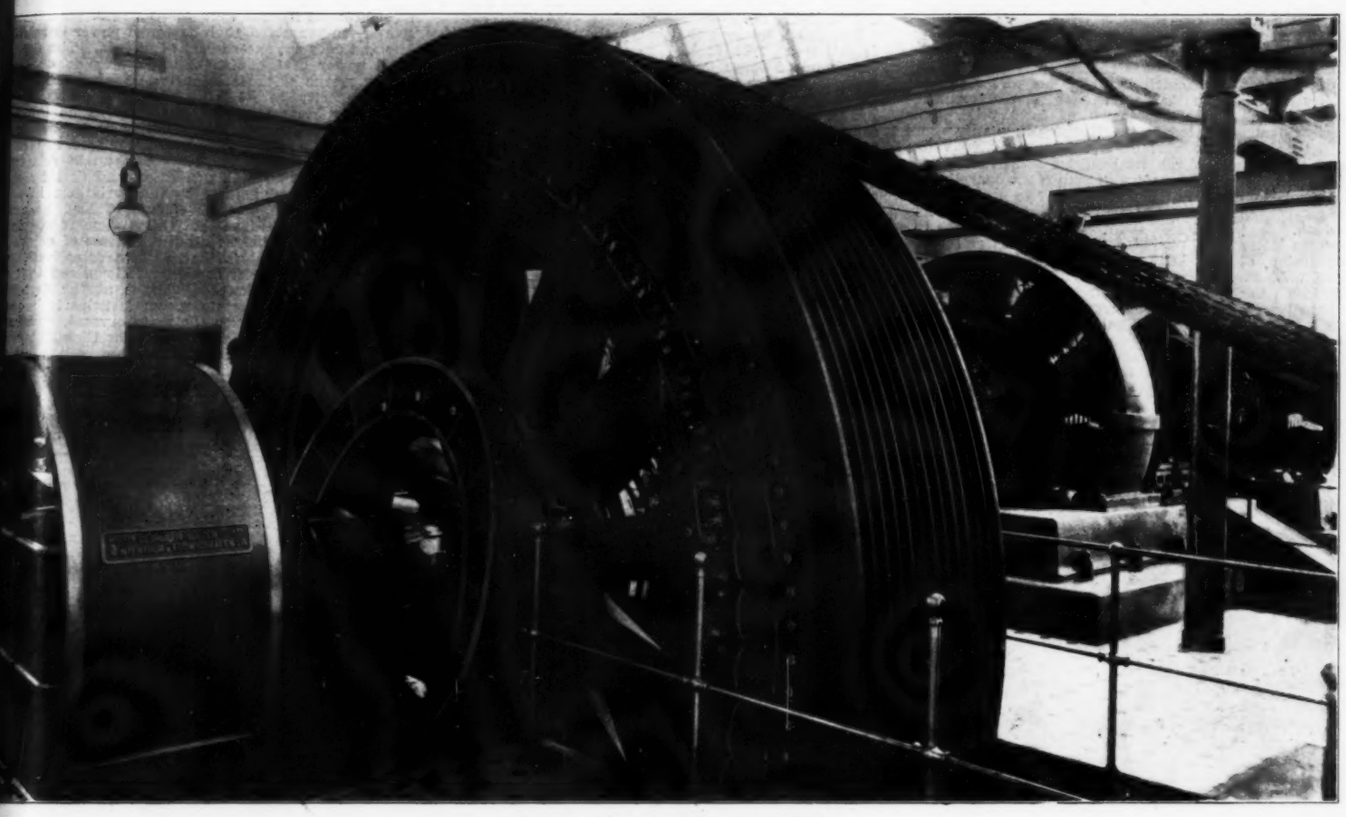


A SIX-HUNDRED-KILOWATT GENERATOR.

THE INTERIOR OF THE HOCHFELD STATION.

A THIRTY-THOUSAND-VOLT POWER TRANSMISSION LINE.

THE FIRST TRANSMISSION OF ENERGY IN EUROPE BY MEANS OF TRIPHASE CURRENTS.*

By EMILE GUARINI.

THE transmission of electric energy from Hochfelden and Glattfelden to Oerlikon (a distance of about eleven miles) possesses the rare peculiarity of being up to the present the sole installation in Europe in which a triphase current is transmitted at 30,000 volts.

The Oerlikon works made this installation for the purpose of collecting accurate data for other installations, rather than for a really industrial purpose. It possesses, moreover, another factor of interest, and that is of being a sort of adaptation of an old installation of 15,000 volts. With a view to economy, the old material has been utilized to as great an extent as possible. But, for certain machines, the result has been a lower efficiency than that attained in the Oerlikon plant. Per contra, it has furnished many interesting data and been the cause of the devising of several peculiar arrangements.

The mean total energy furnished by the two hydroelectric plants at Hochfelden and at Glattfelden is 550 kilowatts. The two establishments work in parallel. That at Glattfelden is about one and a quarter miles distant from that at Hochfelden, and furnishes 120 K. V. A. under a tension of 5,000 volts. This energy is transmitted to the Hochfelden plant, where the tension of the current is raised to 30,000 volts; and the balance of the total output at 30,000 volts is furnished by the generators of this plant operating in parallel with those at Hochfelden. The excitation of the generators at Glattfelden is regulated from Hochfelden.

This latter plant includes three turbines and three generators of the "Lauffen" type, furnishing 100 volts and 1,200 amperes at a speed of 187 R. P. M. and 50 periods. Each generator is direct-connected to a triphase transformer of a construction exactly like those that were shown at the Frankfort Exposition in 1892, for the transmission of power from Lauffen to Frankfort. At Oerlikon, the current at 30,000 volts is reduced to 230. The secondary terminals of the transformers of the secondary station are connected to bus bars in parallel with a 600-kilowatt generator direct-connected to a Sulzer steam engine, the normal speed of which is 94 revolutions a minute.

The current is utilized at Oerlikon to operate 200 synchronous motors, 60 of which are used for actuating the traveling cranes.

During the normal service two generators and one transformer are in operation at Hochfelden. The high tension windings of one of the transformers are closed and each phase of the high tension windings of the second transformer is connected separately in series with the coils of the first transformer.

The windings are contained in a cast-iron box filled with oil, which is set in circulation by a pump, and, from the box, passes through a coil of pipe surrounded by cold water. The transformer that transforms the current coming from the works of Glattfelden is cooled by air.

The use of transformers at the primary stations presents several advantages over the direct production of high tensions by alternators. Although the line follows a river and is much exposed to strokes of lightning, none of the parts of the transformers has ever been damaged during a thunder storm. This fact indisputably proves the security of service given a high-tension line by a transformer connected between the generator and the line. Besides, owing to the fact that transformers permit of reaching a tension much higher than that which can be practically produced directly at the terminals of the generators, it will be possible to effect in the transmission line a saving of copper that will compensate for the increase in expenses occasioned by the cost of the transformers. Finally, the liberty in the choice of tension at the terminals of the generator will permit of reducing the cost of the latter, by employing bar windings, for example. At the generators and at the transformers the middle conductor is connected with the water main. At the primary station there is placed in the open air between the line and the transformers fusible bars about three feet in length.

The line itself comprises four conductors 4 millimeters (.157 inch) in diameter. These are spaced 50 centimeters (20 inches) apart, are carried by 260 poles, and are from 8 to 10 meters (26¼ to 32.8 feet) above the surface of the ground. There are but three service wires. The resistance of one of the wires is 31 ohms. At about 1.5 meter (4.6 feet) beneath the wires for the high-tension current is the outgoing and the incoming wire for the telephone. These wires are carried by the same poles as the others. This telephone line connects the primary and secondary stations. The wires are crossed twenty times, for the entire distance. Telephone communications can be kept up during the service. If a defect in insulation occurs in the high tension circuit, the telephone bell immediately begins to operate on account of the dissymmetry of the distribution of electricity. This bell therefore always signals defects in the insulation. At each end, as well as at the center of the line, there are about three lightning arresters of the Siemens type, having a 2-inch air gap. These operate during every storm in the vicinity of the line without the least disturbance making itself felt in the service. Moreover, for several years past there has been no serious derangement of any account in the service due to lightning.

The 800 insulators that carry the wires are of different types. There are also among others, about one hundred large delta bell insulators of 25 centimeters (9.8 inch) diameter, about 300 white porcelain insulators such as were employed on the Lauffen-Frankfort line, about 200 brown insulators of practically the same size, and 200 smaller insulators in the form of a plate.

By means of the Oerlikon high-tension interrupters shown it is possible to interrupt the entire current of the secondary station without any visible spark. The interrupter consists of a lever and toothed sector, and the interruption is effected in porcelain tubes. With one of these interrupters it is possible to break a circuit with a charge of 3,500 horse power represented by a triphase current having a tension of 3,800 volts; and this is certainly an evidence of its excellent construction. The transformer room at the Oerlikon station has four transformers of a recent type—the same as that which before very long will be employed at the primary station as a substitute for the old transformers, which have a low efficiency.

The capacity of each transformer is 150 kilowatts. The high-tension windings as well as the low-tension ones are connected triangularly. The transformers are provided with an oil bath, and the oil is cooled by water that circulates in a spiral pipe arranged in the oil receptacle. If, under a charge of 10 kilowatts, the circulation of water be dispensed with, the temperature of the oil will rise to 35 deg. C. (95 deg. F.). Before long, the transformers of the primary station will be replaced by a modern transformer of 450 kilowatts capacity, with artificial refrigeration by air. The new transformers, one of which is shown, are coils so constructed as to be capable of supporting a service tension of 50,000 volts, in order that experiments also may be made with this very high tension. The difference between the old and the new transformers is very characteristic of the progress made in recent years in the domain of such apparatus. The following are the characteristics of the new type of these apparatus:

Power	150 K. V. A.	
Weight, total	2,200 Kg.	(4,850 pounds)
Weight of copper	200 Kg.	(440 pounds)
Weight of iron plate	680 Kg.	(1,500 pounds)
Weight of oil	650 Kg.	(1,432 pounds)
Weight of oil receptacle	560 Kg.	(1,234 pounds)
Losses in iron	2,200 watts	
Losses in copper	2,000 watts	
Efficiency	97.2 per cent	
Fall of maximum tension	3 per cent	

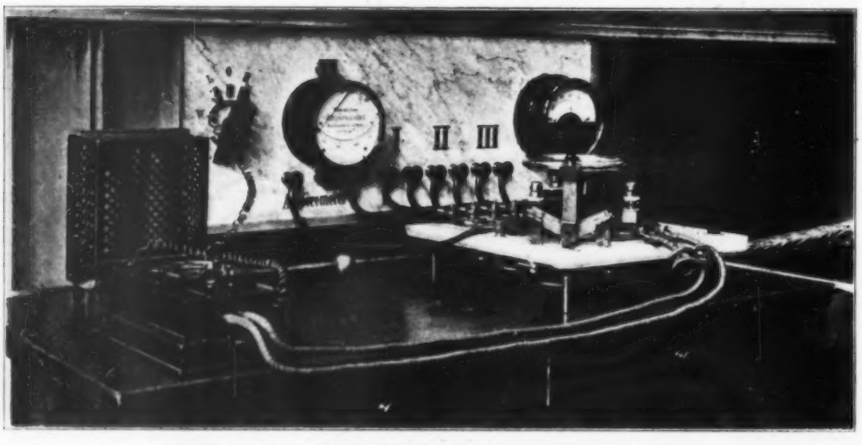
The 600 K. V. A. generator at the secondary station is of the flywheel type with stationary armature and circle of revolving poles. The movable part carries 64 polar cores with magnetizing coils. It has an efficiency of 95 per cent. From the movable part, which is in the form of a channeled pulley, a portion of the energy of the steam engine is transmitted over a main shaft from which it is possible to actuate two dynamos for the lighting. In the construction of the generator it became necessary to take account of the fact that it had to operate in parallel with the transformers, and, consequently, in order to assure a proper operation, to admit for the generator a relatively great fall in tension, seeing that the total difference of the tension of the transmission of energy is about 100 per cent between full load and no load. With a constant speed of the turbines and a constant excitation of the generator, the voltage at the low-tension terminals at the secondary station was when running with no load double the voltage at full load, as long as the transformers of the two stations were in service. With the new transformers, the variation in voltage will be about 30 per cent less. Between full load and no load the difference in voltage of the generator driven by the steam engines, is 40 per cent. Under such conditions the working of the two plants in parallel is obtained without any difficulty. The regulation of the voltage is extremely simple. In the primary station neither the excitation of the generator nor the number of revolutions of the turbine is regulated, and it suffices to regulate the current derived from the exciter actuated from the main transmission shaft at the secondary station. This is done automatically by means of a Thury regulator, which gives extremely satisfactory results. The voltage, regulated automatically by the variation of the shunt current of the exciter, does not vary more than ±2 per cent in ten seconds. As the asynchronous motors were for the most part installed five or ten years ago, their factor of power is relatively low and does not exceed 0.5 at full load. The factor of total power of the distributing system is carried to 0.8 by means of three large synchronous motors of a total capacity of 40 kilowatts. Upon superexciting these they become capable of furnishing an important component of current, which is in advance of the current of the system. The manufacturers are of the opinion that the voltage regulator can be adapted to each exciter or to each generator, and that its operation is influenced neither by the variations in speed, lag in the phase, nor by change of load. There is every reason to believe that this system of regulation will before long replace all the systems of compounding of the alternators that require complicated connections of the exciter or commutations, and that can not act directly upon the voltage at the terminals but must regulate certain magnetic fields in more or less direct relation with the main current. The automatic regulator is a sort of relay for the voltage, and can be over- or under-compounded at will. For this purpose the windings necessary for the compounding are provided for in the regulator.

The elevation of the tension from 15,000 to 30,000 necessitated the replacing of a certain number of insulators that had proved inadequate during damp weather. The transformers wound for a maximum tension of 50,000 volts were afterward installed. Nevertheless, before commencing a regular service with the tension of 30,000 volts, some experiments were made for the purpose of studying the effect of the charging currents upon the current and the tension of the installation, as well as the losses that might take place in the line.

Upon comparing the losses in watts in various experiments, it was found that those upon the line rapidly increased with the tension. They were 1 kilowatt at 20,000 volts tension, 4 kilowatts at 30,000 volts, and 10 kilowatts at 40,000 volts.

It has not as yet been possible to ascertain how much such losses can be diminished by employing larger insulators. Moreover, as we have already said, the tension has not been raised through motives of economy. In making this installation, the Oerlikon works proposed before all else to study thoroughly a high-tension arrangement, to collect practical data, and to find arrangements adapted for assuring an absolutely certain service at such a tension, in order to be able to undertake and guarantee the construction of a 30,000-volt installation. The object of the first experiments was to obtain a general idea of the conditions of operation that had to be expected; but other phenomena supervened to make the question more profound. It was found especially that there was a great dissymmetry between the three phases and that according to all appearances, the influence of the dissymmetry was so much the greater in proportion as the drop in voltage of the generators and transformers supplying the line was greater. The phenomena were identical with the large and small motors.

An endeavor was naturally made to remedy the dissymmetry of the line as simply as possible. In order to do this, the latter was divided into three equal sections, and in each of these the connections of the wires were reversed in a cyclic order. For practical reasons it was impossible to make the three sections exactly equal. The experiments were therefore performed over again after making special arrangements. A special switchboard (Fig. 7) permitted of connecting the main current coil of the voltmeter and am-



TESTING STATION OF THE HOCHFELD-GLATTFELD-ORRLIKON LINE.

TRANSFORMER WITH ARTIFICIAL VENTILATOR.

A THIRTY-THOUSAND-VOLT POWER TRANSMISSION LINE.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

meter, without interruption, one or the other phase. Moreover, it is possible to connect the shunt coil of the wattmeter, between the neutral point of the generator and the different phases, or, if it be desired to measure the watts according to the double wattmeter method, to connect the secondary coil of the wattmeter between two conductors. A special commutator permits of reversing the direction of the shunt current of the wattmeter.

The experiments were performed under very unfavorable atmospheric conditions.

The results obtained have permitted of drawing up the following table, in which are given the losses of energy that occurred in the different atmospheric conditions and at different tensions:

State of the Atmosphere.	Temperature of the air.	Losses in Kilowatts.			
		20,000 V.	25,000 V.	30,000 V.	34,000 V.
Cloudless sky and dry weather	+25°	0.6	0.79	0 9	1.0
Cloudless sky; hail during the night preceding the experiments	+5°	0.68	1.05	1.8	3.1
Fall of snow in very fine flakes, temperature below the freezing point	−4°	?	1.4	2.2	3 9
Sky cloudy, and rain a few hours previous to the experiments..... ..	+7°	1.3	2.0	3.0	4.2
Fall of snow in fine flakes, temperature above the freezing point	+1.5°	1.5	2.7	4 9	8.7

These experiments have shown a curious relation between the current of the line and the watts absorbed by the latter. The intensity of the current increases much more rapidly than the voltage. Such intensity, measured in the low-tension windings of the transformers is proportional to the intensity of the high-tension current.

"It is noticeable that, without exception, these criticisms have been not by men practical in the manufacture of iron or steel, but by that class of scientific dilettante who assume with an array of figures and formula to prove with equal facility either side of a question that their sympathies happen to be enlisted upon.

"The truth of the blast furnace is that it is a highly economical device for accomplishing its end and will continue to be so until methods be found that will perform its functions for less money.

"Some classes of ore may now be more cheaply reduced to metal by other means than the blast furnace, making a product whose analysis cannot be produced in the blast furnace at all. Given a magnetic ore-carrying gangue, sulphur, and phosphorus in prohibitive quantity for making good steel economically, such ores find no market tributary to the blast furnace.

"On the other hand such ores may be crushed, magnetically concentrated, electrically smelted and produce the best of steel at a price which can compete with an ideally situated blast furnace.

"In last year's paper I made the assertion that 'the work of the electric furnace was performed upon a ton of ore with something less than 500 K.W.H. of energy.'

"Upon this basis one of our learned members accorded me an efficiency of 83 per cent, which he followed up by saying was impossible. In truth, at that time I was doing 10 per cent better than that, or an efficiency according to his figures, of 91.3 per cent.

"To-day I am prepared to report to you that I am doing the same but better work, with one-half the K.W.H. reported to you last year, and it is with a spirit of some amusement that I contemplate what efficiency I am attaining to-day, assuming always that upon the basis of 500 K.W.H. per ton I was entitled to an efficiency of 83 per cent. Three problems have presented themselves for solution, in the conduct of my work; first, the power required to agglomerate and sufficiently heat for subsequent reduction; second, the regulation of the size of the agglomerated particles, and third, the amount of reduction of the agglomerated material.

"The status of those three problems to-day is that a ton of ore is being agglomerated with an expenditure of about 250 K.W.H.

"The size of the product is under perfect control.

"The reduction is being made absolute. Inasmuch as the only function of the electric current is to agglomerate the dusty particles into coherent masses without binder or flux, and to convey a sufficient quantity of heat to the ore in the soaking pit, to permit the reducing agents to perform their functions, it will be readily comprehended that the heat and current losses due to maintain a molten mass are lacking."

In the discussion that followed the reading of Mr. Ruthenburg's paper, C. J. Reed, of Philadelphia, asked as to the utilization and disposition of the calories consumed in his electric furnace and soaking or reducing pit. This phase of the question was answered for Mr. Ruthenburg by Alfred H. Cowles, who said he had made a study of the heat efficiency of Mr. Ruthenburg's work.

According to Mr. Cowles' figures, the heat units imparted to the agglomerated ore by the electric current in passing the ore through the rolls, is sufficient to supply the needs of the ore for its reduction by CO, which is supplied to the bottom or cooler end of the soaking or reducing pit. The CO is pre-heated by being passed through heated checker work surrounding the soaking pit. The heating of the checker work is accomplished by burning the but partially oxidized CO that comes from the hot ore chamber. The gas heating also makes up for the heat losses from the ore due to radiation.

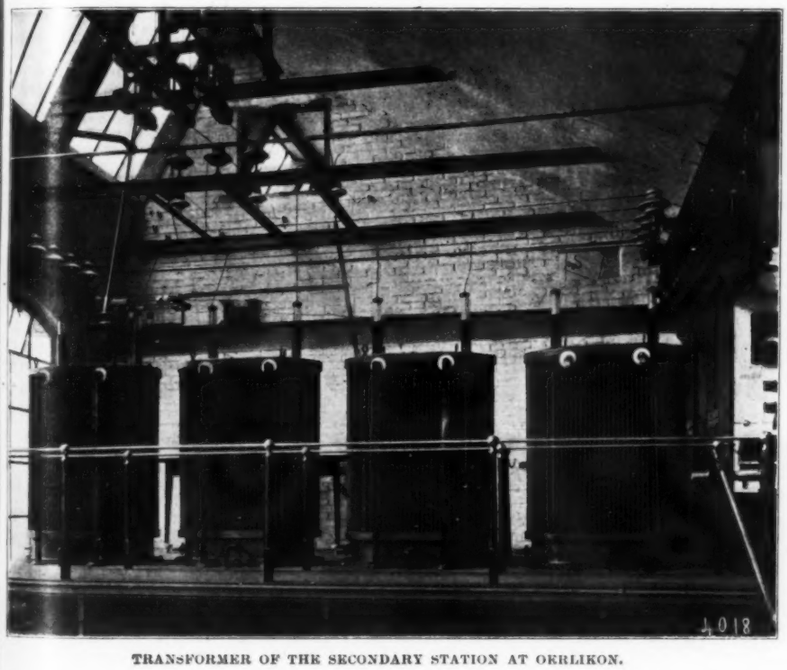
Mr. Ruthenburg spoke of the practically complete elimination of sulphur in his furnace and explained that he was convinced from careful observation, that this was due to the reaction between FeS and FeO, at the high temperature of the electric furnace. Mr. Becker questioned the reaction, citing an experiment which he had made in which he attempted to make metallic iron by the reaction of iron sulphide and oxide, ending in failure. He also cited the unsuccessful attempts to obtain metallic nickel by the reaction of nickel oxide and sulphide.

Mr. Scholl asked as to the purity of the product of Ruthenburg's furnace and what became of the impurities. Mr. Ruthenburg explained that all impurities were primarily removed from the ore by magnetic concentration, so that practically pure iron oxide was what was supplied to the electric furnace. Therefore, the sole duties of the electric furnace were, first, to agglomerate the finely divided portions of ore into solid coherent particles that would not pack and impede the flow of CO. Second, to impart so many heat units to the ore that reduction through CO would be complete.

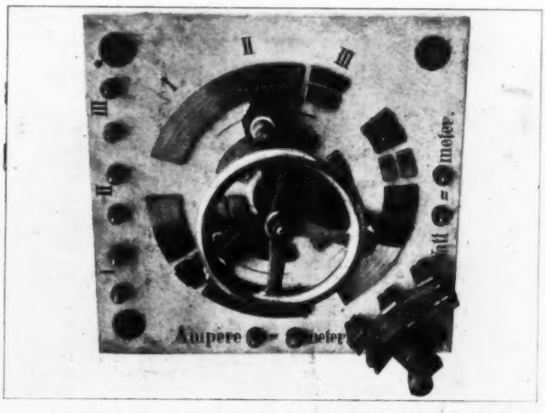
Mr. Ruthenburg also called attention to the fact that iron ore was unique in its property of being reduced by CO at a temperature not very much greater than that of boiling water, although at higher temperatures short of melting the reduction is more rapid.

In closing the discussion, Prof. Richards said that at last year's meeting, in figuring the efficiency of the Ruthenburg furnace, based upon the figures given at that time, he had assumed that the ore was melted and that the work of the furnace was intended to prepare ores for the blast furnace. In the new light of the present day, he congratulated Mr. Ruthenburg on the success of his achievements and thought there was great promise of electrically produced steel assuming an important place in the economic production of that metal in this country.

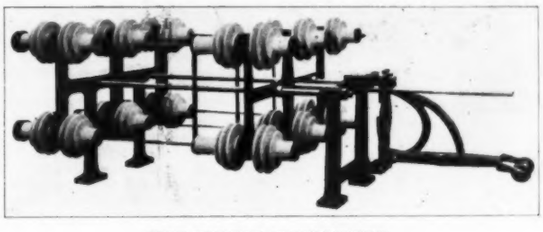
EMANATIONS OF RADIUM.—With reference to recent researches of Crookes on this subject (see The Electrician, vol. l., p. 986), J. Elster and H. Geitel de-



TRANSFORMER OF THE SECONDARY STATION AT OERLIKON.



COMMUTATOR PANEL OF THE HOCHFELD-OERLIKON LINE.



HIGH-TENSION INTERRUPTER.

A THIRTY-THOUSAND-VOLT POWER TRANSMISSION LINE.

This short account, we think, will permit of an idea being obtained of the experiments performed during two years with 30,000 volts. The experiments that it is proposed to make with 50,000 volts will not fail to be interesting, and will permit of collecting a large number of data, both practical and theoretical, upon high-tension transmissions, which data will prove of utility not only for the Oerlikon works, but also for all those who are occupied with the electrotechnics of high tension, into which such experiments might be the means of introducing important modifications.

ADVANCES IN THE ELECTRO-METALLURGY OF IRON.

ONE of the most interesting papers read before the fourth general meeting of the American Electrochemical Society, held in Niagara Falls September 17, 18 and 19, was that of Mr. Marcus Ruthenburg on "The Advances in Electro-metallurgy of Iron Production." Mr. Ruthenburg has for years been experimenting in this important field, and has contributed much to what appears to be approaching success in the development of an economic process, so that what he says on the subject is of world-wide interest.

Mr. Ruthenburg's paper and the discussion that followed were as follows:

"At the last meeting of the Society a paper was read for me upon the 'Electro-metallurgy of Iron and Steel.' In the discussion which followed the reading of the paper, as well as in the technical press of this country and Europe, there has been a mild skepticism as to the possibility of competing with the blast furnace in the production of iron and the further reduction of this iron into steel by the Bessemer pro-converter or the Siemens furnace.

scribe a peculiar kind of scintillating phosphorescence produced in Sidot's blende by radio-active emanations. They introduced an insulated screen of sidotblende, which had been kept in the dark for several days, in a dark space about 1 meter in cubic extent containing radio-active emanation from the soil. On maintaining the screen for two hours at a potential of −2,000 volts, it became luminous. On examining it in the dark with a magnifying glass it was seen that the luminosity was not uniformly spread over the surface, but consisted of numberless stars appearing only momentarily. With the aid of strong radio-active bodies, the scintillating phosphorescence could be made very intense. An important and characteristic distinction from the phosphorescence produced by light is that the new phosphorescence is not extinguished by red light. Blowing an air current over the screen, or pressing it against a glass plate, produced no effect upon the scintillations, and this squares well with Crookes's idea that they are the accompaniment of the projection of electrons from the screen. A calcium tungstate screen shows only ordinary phosphorescence, but a thorium oxide screen shows scintillating phosphorescence even after positive electrification.—Elster and Geitel, Phys. Zeitschr., May 1, 1903.

CHEMICAL AFFINITY AT LOW TEMPERATURES.—Having found that solid fluorine and liquid hydrogen are capable of combining at temperatures as low as −252 deg., or 21 deg. absolute, H. Moissan and J. Dewar have further studied the affinity of fluorine at −187 deg. They find that that affinity is sufficient to produce the combination of sulphur, selenium, phosphorus, or arsenic without external energy, to decompose calcium oxide with bright incandescence, and to produce the explosion of a mixture of anthracene and fluorine.—Moissan and Dewar, Comptes Rendus, March 30, 1903.

USE OF THE INCANDESCENT MANTLE IN LIGHTHOUSES.

IT is often said that the invention of the incandescent mantle saved the gas industry from the deadly competition with which electricity was beginning to threaten it. But it is not only public and domestic lighting that the incandescent mantle has come to transform. In France, although the fact is not generally known, it is now currently employed in lighthouses, and, although it does not possess the same formidable power as the electric arc, it has at least permitted of substituting simpler apparatus—affording greater brilliancy

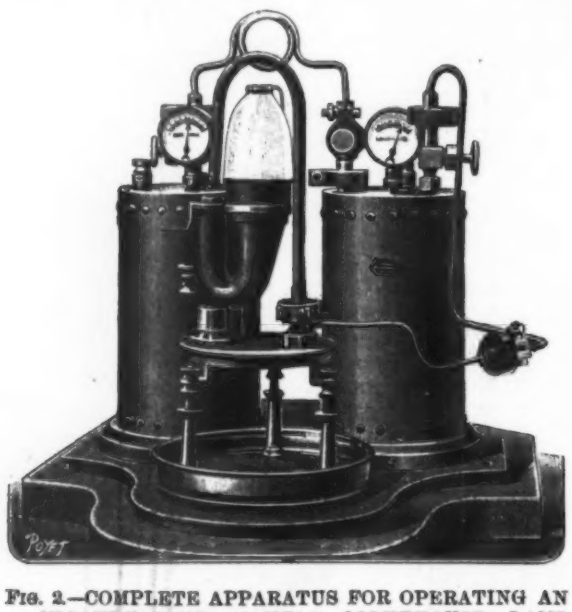


FIG. 2.—COMPLETE APPARATUS FOR OPERATING AN INCANDESCENT MANTLE LIGHTHOUSE LAMP WITH KEROSENE.

than the old kerosene lamp with many wicks. Therefore, except in cases where a light of exceptional power was needed, the incandescent mantle has replaced the kerosene lamp, and considerable saving has been realized. Up to 1894, the sources of light employed were mineral oil burners, with numerous wicks, and the electric arc, which it became necessary to discard in some of the 46 lighthouses projected in 1882, on account of the expense that it would have involved. It became necessary to find something else, because, as the lamented M. Bourdelles has shown, the increase of power and intrinsic brilliancy in mineral oil lamps grows less in proportion as the size, and consequently the consumption of the burner is increased. Into this process, then, but very few improvements could be introduced, so this led to the adoption of an entirely new method—the use of the Auer mantle made incandescent by gas, which gives luminous sources of much greater intrinsic brilliancy. It was evidently unnecessary to endeavor to use the ordinary burner employed in city lighting, the intensity of which does not exceed that of mineral oil burners with two or three wicks, and the lighthouse service therefore devised a special and very simple apparatus that burns oil gas at a pressure that permits of discharging a large quantity of it upon the mantle. In this way there have been obtained luminous sources, which, while being sensibly more economical, have a mean special brilliancy triple that of the 3 or 6-wick burners such as are installed in first-class lighthouses. The burner (Fig. 1, No. 2) consists of a vertical tube, *T*, provided at the upper part with a Bunsen burner and a mantle. At the base of this tube is arranged an ejector, *E*, provided with a capillary aperture, *i*, through which the compressed gas makes its exit. This latter, in expanding, combines with the surrounding air and becomes intimately mixed therewith in the tube, *T*. The discharge of the gas depends upon the pressure and the diameter of the ejector, while that of the air is determined by the diameter of the orifices at the base of the tube, *T*, which are so regulated that a perfect combustion may be obtained. It has been found that the consumption diminishes in proportion as the pressure increases up to 1.42 pounds to the square inch, and with 2.27 pounds to the square inch pressure the consumption is 5.65 cubic feet an hour. Uniform operation is assured by an expander. There has also been put in service a slightly different burner (Fig. 1, No. 1) in which a 1¼-inch mantle is employed, and which burns 19.42 cubic feet an hour.

Nevertheless, lighting by oil gas had still one drawback, and that was the expense incurred by the establishment of a small gas works in each lighthouse. An endeavor has been made to do away with this inconvenience by producing the incandescence through the vapor of petroleum, although the same end might possibly be attained by the use of the vapor of alcohol. The burners employed have various forms, but are all based upon the principle which is now utilized in alcohol lamps, and which consists in injecting the liquid fuel into a vaporizer heated by the mantle itself, the vaporizer being at the outset raised to the proper temperature by burning a small quantity of alcohol. The vapor then goes to the Bunsen burner of the mantle after admixture with air in the proportion desired.

When the nature of the optical apparatus permits, the vaporizer is made in the form of an inverted U, the branches of which embrace the mantle as closely as possible, and which is directed according to the diagonal plane in which its presence does not involve any inconveniences as regards occultation (Fig. 1, No. 3). When the case is otherwise, an arrangement is adopted (Fig. 1, No. 4) in which the petroleum inlet tube is placed alongside of the vaporizer. The two tubes produce a single occultation in a dark sector, or on the side toward the ground. These two types of burners require for their operation merely the addition of a reservoir of petroleum connected with another fitted with air at a pressure of 85 1-3 pounds to the square inch. The conduit that connects them carries a pressure gage and a small expander that permits of regulating the pressure exerted by the air, which should be at least 35½ pounds. The discharge of the petroleum is regulated through a specially arranged needle valve.

These apparatus are provided with 1.18-inch mantles; but, since the arrangement just described had some drawbacks, there has been more recently adopted a burner that, to a certain extent, recalls the first one above mentioned, with two tubes for rendering 2-inch mantles incandescent. Here the increase of lighting surface renders the occultation of slight importance (Fig. 1, No. 5).

These successive improvements have given most excellent results in the process of lighting, which had already been considerably transformed by the adoption of the principle of incandescence. The fact is that with the primitive oil gas burners, the intrinsic brilliancy is equal to 2, while it reaches 2.5 with the ordinary petroleum vapor burners, and 3 with the last type that we have briefly described.

The consumption of petroleum may descend to 4 grammes (0.141 ounce) per carcel (=9½ candle power) of intensity obtained; in practice, the consumption does not exceed 5 grammes (0.176 ounce), which is very small. The annual expenses necessitated by a petroleum incandescent burner are no greater than those of a 4-wick lamp, and yet a much more powerful light is obtained. The only thing to be feared is the clogging up of the ejector through the particles of tar carried along by the gas; but this can be fully remedied by a careful cleaning of the vaporizer, or even by clearing the ejector with a needle.

Referring to the most recent experiments made by the lighthouse service, we may say that a great deal of attention has been paid to the possible application of acetylene, which would permit of carrying the incandescence of mantles still further, and that just at present some burners manufactured by the Compagnie de l'Acetylene Dissous are under experiment. These burners are provided with 2-inch mantles, which, with an effective pressure of 1.1 pounds to the square inch upon the acetylene, gives an intrinsic intensity of 6.7 per square centimeter with a consumption of 2.6 liters (.09 cubic foot) per carcel burner (Fig. 1, No. 6). These experiments with acetylene are taking place at Chassiron, by means of a gas generator that furnishes in the morning, and at once, the entire quantity desired for the lighting for one night, without its being necessary to touch the apparatus.

These incandescent arrangements cannot cope with the electric arc as regards brilliancy, but electric light costs almost too much for the power demanded of the majority of lighthouses.—Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

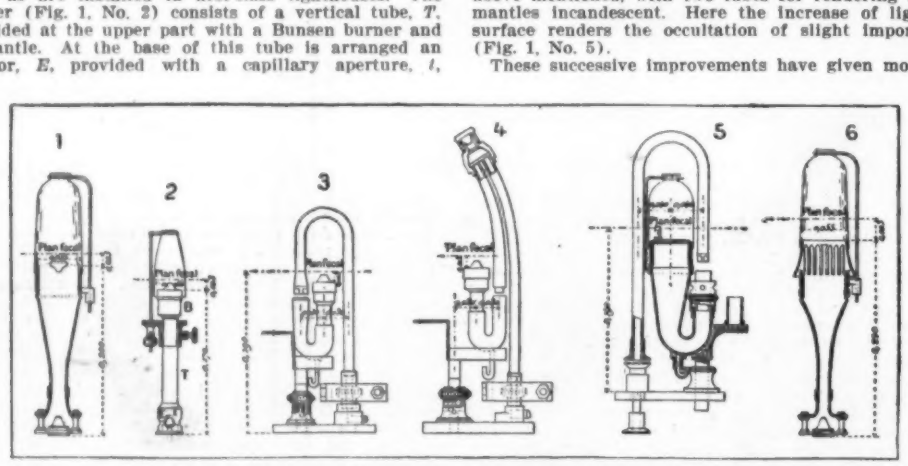


FIG. 1.—INCANDESCENT BURNERS FOR LIGHTHOUSES.

1 and 2. Gas burners. 3, 4 and 5. Petroleum burners. 6. Acetylene burner.

TESTING THE SPECULA OF REFLECTING TELESCOPES.*

A CORRECTION OF A WELL-KNOWN FORMULA.

By JAMES ALEXANDER SMITH.

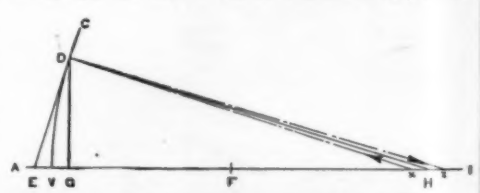
THERE are signs that the reflecting telescope is regaining the high position from which it was temporarily deposed by large refracting rivals.

Perfectly achromatic, simple—there is but one large surface to figure, as against at least four in the refractor—non-dependent upon optical purity of structure, cheap, and capable of giving perfect definition, it is well worthy of close consideration.

The all-important qualities are achromatism and definition. The first is inherent in the type, the latter requires that the optician shall have at his command a perfectly reliable and exceedingly delicate method of testing.

There is little doubt that the reflector, or the observing environment, has not infrequently been condemned as *per se* unsatisfactory, when the defective performance simply indicated that the correction of the speculum was incomplete.

The numerous scientists and scientific amateurs who construct their own instruments, often of large size, are dependent chiefly upon Draper's method of "parabolization by measure," as described in the classic monograph on the "Silvered Glass Telescope," published in the Smithsonian Contributions, vol. xiv., 1865, and in such cases it would be difficult to devise a better system, as a system. It is an effective progress method, carrying the worker steadily on until he can apply the ultimate test of all, stellar observation under rare and perfect conditions of atmosphere. From that decision there is no appeal.



REFLECTING TELESCOPE.

Obviously, the telescopic performance of a speculum so tested, will be dependent upon the soundness of the mathematical reasoning underlying the formulæ used, the correctness of subsequent computations, and the closeness with which they are approximated by manipulation.

Unfortunately, there is an error of 50 per cent in Draper's deductions, and the consequent loss of the higher qualities of an instrument may be much greater, yet the formulæ are frequently quoted, or referred to in technical literature,† without a hint given that emendation may be necessary. That warning may be needed is illustrated by the fact that one English professional maker supplied with each of his mirrors a chart showing the concordance of the measured results at each zone, and those computed by the equation referred to.

The initial premises of this paper are:

I. That a truly parabolic form of section is desired.

II. That the reader has a theoretical, or better, a working knowledge of "parabolization by measure."

III. That the radiant (or "pinhole") is, as figured and described in the Smithsonian Contributions (and in the many literal reproductions which have appeared since), a fixed point in the axis of the mirror, situated at twice the principal focal distance from the vertex, or "at the center of curvature."

N. B.—An easily accomplished approximation in practice suffices, as, presuming fixity, a slight axial difference between the radiant and "center of curvature" does not introduce appreciable errors in the final quantities.

The succeeding geometric analysis is based upon well-known properties of the parabola, to be found rigidly demonstrated in elementary works on the conic sections. It is simplified in order that non-mathematical readers may, by following the reasoning, or even by the use of compass and scale upon exaggerated diagrams, convince themselves of the truth of the final deductions; to geometricians these will be almost self-evident.

Let *A B* be the axis *F* the focus, and *V* the vertex of a parabolic curve, *VC*.

Then, if from any point *D* in the curve *VC*, a tan-

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

† SCIENTIFIC AMERICAN SUPPLEMENT, Sir Howard Grubb, p. 8771, No. 549; Edmund M. Tydeman, p. 20001, No. 1804, etc. Also by eminent astrophysicists in recent American literature.

gent *DE*, ordinate *DG*, and normal *DH* be drawn to meet the axis:

I. The subnormal *GH* is of constant length, irrespective of the position of *D* in the curve, and is constantly equal to twice the principal focal distance *VF*.

II. The subtangent *EG* is equal to twice the abscissa *VG*.

III. The relation between the subnormal *GH*, ordinate *DG*, and subtangent *EG*, is expressed thus: *GH* : *DG* :: *DG* : *EG*.

Since *GH* is a constant, the point *H* will be at its minimum distance, equal (by I.) to 2*VF* from *V*, when *VG* vanishes, or when *G* coincides with *V*; that is, when the point *D* is taken at *V*. Let the axial point marking the minimum distance of *H* from *V* be taken as datum, and be denoted by *x*.

Obviously, as *D* is moved in the curve from *V* toward *C*, *VG* will increase, and the distance *xH* will (by I.) be constantly equal to *VG*:

But (by II.), *VG* is equal to one-half of *EG*—
And (by III.), *GH* : *DG* :: *DG* : *EG*—
Therefore (expressed algebraically)—

$$(xH) = \tfrac{1}{2}\ (EG)$$

$$= \frac{(DG)^2 \div (GH)}{2}$$

$$= (DG)^2 \div 4\,VF$$

or, in words: The axial distance of a normal from the point *x* is equal to the square of the related ordinate divided by four times the principal focal length.

The value of this step in the process so determined is given as the final result by Draper. In minor working the two quantities required to find the axial position of the normal for a given zone are known; 2*VF*, or twice the principal focal length, is the equivalent of the radius of the circular templet most nearly matching the curve of the mirror; *DG*, or the ordinate, is half the diameter of the zone under test.

But the position of *x* in reference to *H* does not, as many writers and constructors appear to assume, denote the aberration, unless both the "pinhole" and "knife-edge" move longitudinally *together* as common parts of a plane perpendicular to the axis. With that arrangement the incident ray, normal and reflected ray are coincident, and the preceding equation expresses the zonal aberration to be allowed. But, as specified and illustrated by Draper, and as probably almost always arranged, the radiant is at *x* and fixed. The equation then ceases to apply.

Because, if *x* does not coincide with *H*, then by the laws of reflection, the angle between the incident ray *XD* and the reflected ray *Dz* will be bisected by the normal *DH*.

Hence the reflected ray will cut the axis at a point *z*, making the portion *Hz* of the axis equal—sensibly—to *xH*.

Therefore the apparent aberration, as defined by the axial distance between the "pinhole," or radiant fixed at *x*, and the "knife-edge" at *z*, is equal for any given zone to *twice* the value found by the preceding equation. When *y* equals the semi-diameter of a given zone and *f* equals the principal focal length, the true expression for the distance between the radiant and the knife edge is

$$\frac{y^2}{2f}\ *$$

This is twice the quantity called for by Draper's formula, which therefore errs in the direction of undercorrection.

It has been indicated that this 50 per cent does not fully represent the whole loss of efficiency. A numerical example may make this clear.

Assume a perfect Newtonian speculum of 48 inches in aperture and of 32 feet focal length. The focal image of a star will be, not a point, but owing to interference phenomena, a "spurious disk" (the greater the aperture the smaller the disk, hence a theoretical advantage of large mirrors in point of definition), subtending about 1-10 of one second of arc at the focus, equal to about 1-6000 of an inch diameter. Hence rays diverging from their true courses, but still falling within that circle will not detract from the highest definition the aperture is capable of affording. It follows that the related longitudinal aberration of about 1-750 of an inch at the focus of the telescope is also negligible and represents the amount permissible without deviation from the acme of perfection. This amount is quadrupled at the "center of curvature," and becomes 1-187 of an inch.

Draper's formula gives a result in defect to the extent of ¾ of an inch at the "center of curvature," or 3-32 of an inch at the telescopic focus, connoting at the latter point a circle of confusion of about 1-85 of an inch in diameter, a dimension vastly in excess of the minimum 1-6000 possible.

It follows that the focal images of closely adjacent points, whether stellar and isolated in space, or elements of lunar or planetary surface detail, would be lost by the overlapping of their associated circles of confusion, and that the resulting definition would be, not that theoretically due to reduced "spurious disks" consequent upon enlarged aperture, but to the wholly extraneous areas of confusion due to inaccurate figuring. Unless, perhaps, for use upon ill-defined nebular objects, or for purposes when "light grasp" is the chief essential, such an instrument would be of inferior value, the potentialities of its aperture would be missed, and the additional cost and inconvenience arising from its dimensions uselessly incurred.

It is no mean task to attempt to concentrate the light from some 12½ square feet of surface into about the one forty-millionth of a square inch, yet that is what the preceding numerical example implies.

It is very certain such results could not be approached by the archaic devices and unrigid supports so often described. For instance, the conventional 1-200 inch pinhole is quite large compared to a 1-6000 inch spurious disk, and would permit of an uncertainty of the position of *z* to the extent of about 2-25 of an inch—the writer has in some special cases in research located *z* to within 1-1800 of an inch—and it may well be that from such causes the difference, in the workshop, between a perfect and an under- or over-corrected specula, may be completely masked even when grave errors exist.

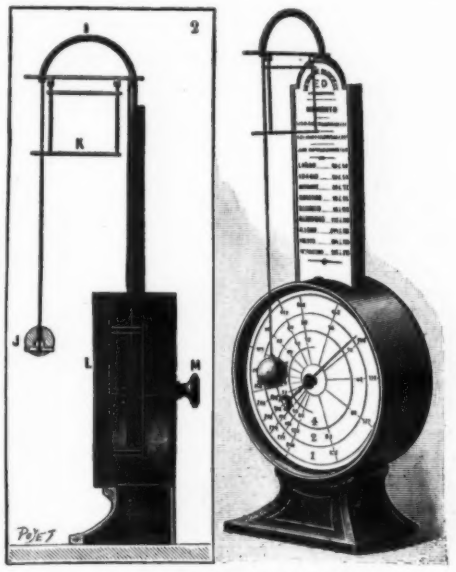
It is to be hoped that in the near future some of these errors and difficulties may be swept away, and with them the haze which at present obscures some of our windows into the outer universe.

Melbourne, Australia.

* This is also equal to twice the depth of the curve at a given zone—a fact which may enable workers to avoid computation by actual measurement.

A SILENT METRONOME.

THERE are numerous metronomes in existence, but all have the drawback of being noisy when they have to be employed, not by beginners who have need of the characteristic tick-tack to keep them constantly in



SILENT METRONOME.

1. View of the apparatus. 2. Section of the mechanism.

rhythm, but by artists, singers, musicians, or composers, who require of this instrument simply a rapid indication of the measure that they desire to follow. In this case, an indicator is needed that shall show the measure solely through the silent swinging of an arm of some kind. Such a want is supplied by the Endrès and Decastiaux metronome.

This apparatus, which, at first sight, somewhat resembles a barometer surmounted by a thermometer, gives all the measures used in music, from 40 units of time to the second, corresponding to the largo, up to 240 units, or the prestissimo. The apparatus is based upon the oscillations of a pendulum, but an ingenious arrangement has been devised to permit of obtaining the manifold beats without the use of a thread of immoderate length and in nowise practical, and of likewise affording a means of instantaneously regulating the metronome for all measures without having to stop it. In order to realize such a desideratum, the time is counted by simple beating, double beating, or quadruple beating. For this purpose the dial of the metronome is divided into three circles, as may be seen in the figure, marked by the numbers 1, 2, and 4. The measures indicated upon the circle 1 (from 126 to 240 units a second) are counted by simple beating; the measures of the circle 2 (61 to 120) are counted by double beating; and, finally, those from 40 to 60 on circle 4 are counted by quadruple beating. Let us recall the fact that a beat is the time that it takes the pendulum to swing once from right to left or inversely. In order to regulate the apparatus to the desired measure, by means of the button, *M*, placed in the rear, the hand seen upon the dial, *L*, is brought to the proper figure, with the result, as we shall see further along, that the motion decreases or increases the length of the suspension thread. The ball, *J*, that terminates the thread is then made to swing once by hand, after which the oscillation will continue silently for several minutes.

If it be desired to modify the measure while the apparatus continues to operate, all that has to be done is to turn the button, and the hand operatively connected with it, through the rod, *C*, and this elongates or shortens the thread.

In fact, if we examine the interior of the instrument, we shall find that the thread starts from a channeled pulley, in the axis of which is centered the rod that carries the hand, the axis coinciding with that of the indicating table. The thread afterward ascends vertically, passes into a tube, *I*, which is curved beneath, and makes its exit opposite what constitutes the oscillating axis of the system. Over the metronome, in fact, is arranged a fork, *K*, provided at its upper part with two junction points, and that serves to regulate the thread (and also the bob) in its motion parallel with the dial. It will be seen that, owing to this combination, since the rotation of the button carries along the channeled pulley, *D*, it will shorten or lengthen the thread in displacing in a corresponding manner the hand that indicates the measure. For each length, the number of the isochronous oscillations is proportional thereto. The thread is long enough to give the minimum of 126 simple beats. The diameter of the pulley is exactly calibered for the various measures, that is to say, for reducing to an exact degree the length of the thread for such or such an angle of displacement of the button, pulley, and hand.

The bob at the extremity of the thread consists of a small copper sphere, *J*. There is nothing peculiar about it save that it carries at its lower part a small screw that traverses it and upon which the end of the thread winds. It is thus possible to regulate the metronome by the tightening or loosening of the screw in case the thread should become elongated or shortened, or the number of beats should no longer be exact through the metronome being out of order.

Above the circular part of the apparatus there is a vertical table which masks and protects the tube in which the thread rises, and which gives a few indications as to the musical movements of the various measures.—Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

SEWAGE PURIFICATION PLANTS FOR SUMMER COTTAGES.

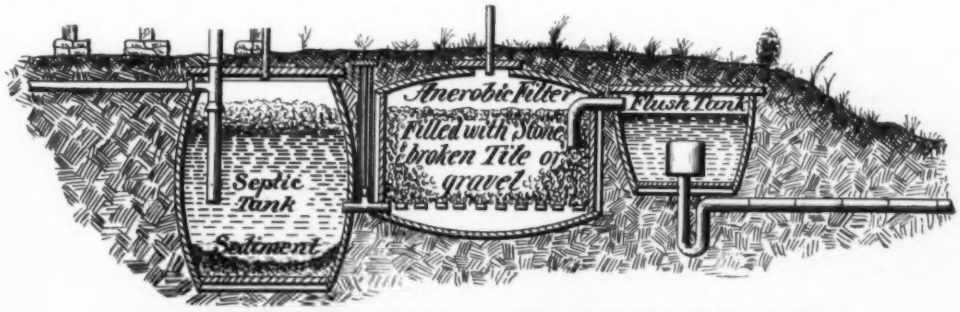
By JOHN W. ALVORD, Sanitary Engineer, Chicago, Ill.

THE importance of providing adequate and proper sanitary arrangements for cottages in summer resorts cannot be overestimated when it is considered how rapidly such resorts have grown in the last few years and how closely crowded together cottages are in most cases. The American people are turning their attention to summer homes in large numbers, and one of the first inquiries upon which they wish to be assured is that they shall have pure water and proper sanitary arrangements. Failure to provide these two essentials (especially important in country life) is to deprive the summer resort of its greatest benefit to the tired city worker.

Investments in summer resort property are generally made on the basis of the least possible expenditure consistent with comfortable living, and it is too often the case that sanitary arrangements are not perfect, or are left to the neighborhood plumber. If there is no sewer system—and generally there is not—the plumber's idea of sanitation will revert to the old idea of cesspool, which will prove in almost every case to be a nuisance.

It is with the idea that modern improvements in the septic tank and subsequent filtration can be adapted for summer resort cottages, where sewer systems are impracticable and the soil of a porous nature, that the accompanying design has been made.

The flush closet may be situated within the cottage or in a building attached to it, as may be desired. It is not a part of the design, except to show its general arrangement. The plant proper is arranged so as to utilize materials which may readily come to hand as far as possible. Three oak casks, such as are ordinarily used for vinegar, may be purchased at second-hand, and when arranged as shown in the drawings will form the septic tank, the anerobic filter, and the flush tank. The inlet to the septic tank should terminate at about the center of the septic tank as shown, and should be ventilated with a one-inch pipe conveniently located. From the septic tank the sewage will flow through a short connection to the anerobic filter, which should consist of an oaken cask buried with its side down. Across the bottom of the cask should be laid a grating of sticks of sufficient strength, so that the filtering material may rest upon them, leaving a free opening below for the circulation of the incoming flow. The materials with which the anerobic filter should be filled should be fairly coarse at the bottom, growing finer toward the outlet from the filter. A graduation from egg to chestnut size would be desirable. The outlet from the anerobic filter should be of a piece of elbow pipe near the top of the cask, so set that it will control the level of the liquid both in the septic tank and the anerobic filter. Provision should be made between the septic tank and the anerobic filter for emptying the larger portion of their contents at the end of the season. The



SECTIONAL VIEW OF COTTAGE SEWAGE-PURIFICATION PLANT.

device shown in the drawing consists of a tee in which a wooden plug fits, which is removed by being fastened to a stick coming to the surface of the ground. This will drain the casks below the level of the cast-iron pipe and prevent any trouble from freezing during the winter.

The flush tank consists of a cask sawn in half and covered with plank as shown. A good three-inch cast-iron siphon should be set in its bottom. This is really the most expensive item connected with the plant, and upon its regular action will largely depend the success which the plant will show. The flush tank will fill and empty in proportion as the closet is used, and probably will be discharged at least twice a day in

ordinary cases. The outlet of the siphon is connected with a line of ordinary farm tile, the grade of which in porous soils should be away from the flush tank at the rate of about 0.2 foot in a hundred feet. If laid in fine sand the joints of the farm tile should be surrounded with coarse gravel or tar paper to prevent the sand from entering the tile. In localities where the ground is not sufficiently porous, greater length of tile should be laid, but in fairly porous soils about one foot of tile ought to be laid for every gallon of sewage passing through the plant in 24 hours.

In very stiff and impervious soils a trench should be dug two or three feet below the level of the tile, and underdrained to some outlet in the vicinity. The trench should then be filled with coarse sand and gravel, beginning with the gravel at the bottom. The discharging tile should then be carefully laid as heretofore described. The top of the trench may be then covered with soil, and no difficulty ought to be experienced with over-saturation.

The total expense of the plant here shown, not including the closet or closet bowl, will be about $25, although this will vary in different localities, depending upon the porosity of the soil, the cost of the materials, labor, and other items.

ENGINEERING SUBJECTS AT THE BRITISH ASSOCIATION: A RETROSPECT.

IN opening the proceedings of the Engineering Section at the recent meeting of the British Association, Mr. Charles Hawksley made reference, in his presidential address, to technical education—a subject that is discussed at almost every meeting of scientific bodies in the present day. Mr. Hawksley was commendably brief in dealing with this question, and the most noteworthy feature of his remarks was an expression of the hope that in the future training of engineering students, increased attention would be paid to the combination of artistic merit with excellence of structural design. With this aspiration we are most heartily in accord. It may or may not be true that, as we are sometimes told, architects are taught design without adequate training in construction, but it is tolerably certain that engineers receive practically no instruction with regard to artistic design. Undoubtedly, it is a fact that the main outlines of an engineering structure are dictated by principles that inevitably lead to correct results, but engineers very frequently go astray when dealing with final details, which cannot be designed by the aid of mathematics. There are many forms of engineering construction in which any attempt to improve upon the absolute simplicity of pure structure would only lead to grotesque absurdity; and on the other hand, there are many types of engineering work, especially bridges and other structures of monumental character, where complete harmony and correct effect are only attainable by the combination of science with art. Considering the many subjects that must be mastered by the engineering student, we do not for a moment believe that it would be possible for him to acquire a sufficient knowledge of artistic design, so as to enable him in after practice to dispense with the co-operation of the architect when important structural works have to be erected in public places. Still, the idea brought forward by Mr. Hawksley is a good one, and we should like to hear more of the suggestion.

After mention of the valuable work now being conducted by the Engineering Standards Committee, the subject of intercommunications was taken up by the president of the section. Road traffic, self-propelled vehicles, electric tramways, light railways, and railways were in turn reviewed. Referring to what we are now almost compelled to term "steam railways," Mr. Hawksley showed that several of the leading railway companies are now turning their attention to improved methods of traction, and he instanced the Mersey Railway as the first example of a British railway converted to the use of electric traction. It is interesting to note that on this line adequate precautions have been taken against fire. The electrical equipment is thoroughly fireproof, the motor compartment being cased in asbestos slate, cutting it off completely from the remainder of the train.

The address was further devoted to canals, shipbuilding, wireless telegraphy, and sewage disposal, and after some remarks on the Liverpool docks and the Nile irrigation works, it concluded with a somewhat technical consideration of waterworks engineering and management. As an introduction to the discussions to be anticipated at a meeting of engineers of all classes, this address was in every way suitable. Practically every department of engineering received due notice, and the author did not omit to speak fully on the subject—that of water supply—with which he is most intimately associated. It is rather a pity that this spirit of catholicism was less evident in the business afterward coming before the section. Although many instructive papers were read, too large a proportion referred to electrical apparatus and traffic problems, while constructional engineering scarcely received the attention that might have been expected. It is true that Mr. Cuthbert Brereton gave a short description of the new bridge at Kew, but this was the only communication relative to structural work.

Mr. J. Harrison followed with a paper of purely mathematical character, illustrating the application of graphical methods to engineering computations, and more particularly to such as are necessary in machine design. This, again, was the only paper in its class, a circumstance not altogether to be regretted, for although the science of mathematics is of paramount importance, we are not quite sure that it is a subject that can be usefully and sufficiently discussed during so brief a session as that of the British Association.

At the next day's meeting attention was almost exclusively devoted to the question of road locomotion and motor traffic. A report was received from a committee, of which Sir John Thornycroft is chairman and Prof. Hele-Shaw is secretary, appointed to consider the resistance of vehicles to traction. In this report were described experiments made with different kinds of tires on different forms of roadway and at varying velocities of travel. From diagrams given, it appears that tractive effort diminishes proportionally with the increase of velocity. The explanation of this suggestive fact is probably that the faster a wheel travels the less time it has to fall into the hollows in the roadway, with the result that it skims along the tops of ridges and irregularities. Some further experiments, made with the object of ascertaining the most suitable design of wheel for heavy traffic, were also described in the report, the general conclusion being that little advantage is to be gained by adopting tires of more than 9 inches wide in the direction of reducing road resistance and damage to the surface. We observe that further experiments are proposed for the purpose of testing the accuracy of this conclusion. At the same time it would be desirable to inquire into the best means of preventing the clouds of dust which are the usual accompaniments of self-propelled vehicles traveling on macadam roads in dry and even in moderately dry weather. It is no doubt desirable that the expenditure of mechanical power should be kept within proper limits, but to the community at large it is more important that the dust-producing power of mechanically-propelled vehicles should be reduced to a minimum.

This point was discussed in connection with a paper by Mr. Clarkson on "Locomobile Design." Mr. Worby Beaumont then stated that trials were about to be made with the view of ascertaining the best means of preventing dust, and he appeared to be of opinion that the dust question could probably be settled by improved road construction. We cannot agree with this view so far as macadam roads are concerned, for a low-bodied motor-car is capable of raising large volumes of dust from the very best forms of surface. The nuisance might be mitigated in some measure by enacting that no part of the body of any self-propelled vehicle should be nearer the ground than, say, 3 feet; but it seems probable that the only real remedy would be the universal adoption of tar macadam or asphalt. Such a proposal would at once suggest difficulties of economic and fiscal character which we cannot now pause to discuss. It is evident, however, that so long as road surfaces are formed of friable materials, merely bound together with powdered stone and water, there will always be dust that must inevitably be raised by wind, vehicles, and other disturbing elements.

The last paper contributed at the sitting to which we now refer was by Col. Crompton, R.E., on "The Problem of Modern Street Traffic." It was pointed out by the author that, notwithstanding the improved means of communication now available, the average speed of travel in large cities does not exceed about five miles an hour. This anomalous and highly unsatisfactory condition is largely brought about by the enormous amount of traffic conducted at a walking pace, and also by the obstruction of streets by vehicles standing at the curb, or aimlessly wandering from place to place. Foot passengers also add to the difficulty, as they are at present entitled to the use of the roadway or footway just as they please. In order to deal satisfactorily with these and other difficulties, the author advised the establishment of a department of the police to take special control of street traffic. This department would be empowered to determine what classes of vehicles were fit and proper to be employed and to advise authorities as to by-laws and regulations, and upon street improvements, crossings, railways, subways, and tramways.

Those who have observed the peculiarities of London traffic know how lamentably deficient are the existing means of control. The utmost latitude is extended to obstruction, and very little endeavor is made to sort traffic according to its character and speed. Omnibus and cab drivers seem to think the streets belong to them; the drivers of heavily-laden drays and wagons dreamily pursue their way regardless of the delay they cause to people in a hurry; and those delivering goods at buildings block up the thoroughfares for hours at a time. No doubt there is very great scope for an able board of experts of the kind proposed by Col. Crompton, and it is to be hoped that the paper to which we refer may have some practical result. In the discussion which followed, Mr. Hawksley made the useful suggestion that roadways should be made with less camber, so that heavy vehicles could more easily be driven close together, and he very properly deprecated the placing of lamp-posts down the center of streets, a bad practice that has been perpetuated by several local authorities during recent years.

On the following day, the report of a committee on screw gages was received, and some papers were read dealing with details of electrical engineering, but being of somewhat abstruse character, they did not appear to attract much attention from the members present. This fact serves to emphasize the remark that a miscellaneous gathering, such as may be found at a sectional meeting of the British Association, does not want to be troubled with papers relating to highly specialized branches of any one department of engineering, especially when the arguments of the authors can only be followed by the careful examination of mathematical formulæ and reasoning. A much more suitable paper was brought forward at the next sitting by Mr. F. B. Behr, who read a communication on "High-speed Express Mono-rails, and the Manchester & Liverpool Express Railway." The system originated by Mr. Behr has already been discussed in the technical press, and there can be little doubt that when one or two successful installations have been made this new means of locomotion will be adopted in various parts of the country. At present there is an idea in some quarters that the public will never consent to be whirled along an electric railway at a speed of something like 150 miles an hour, but, as happened in the case of the existing steam railway system, this feeling of timidity will soon wear off, and the practical annihilation of distance from town to town will in due time be fully appreciated by the public. Whether, however, habitual traveling at such speeds will not have an effect injurious to health, and calculated to shorten the lives of those who indulge in it, is still a very serious question, to which experience alone, perhaps, can supply the answer. Nor can one avoid the reflection how terrible would be the nature of a "railway accident" to a train traveling at such a speed. Not a single passenger in it would survive.

In a subsequent paper, Mr. A. M. Bell gave some interesting facts relative to the progress recently made in the application of liquid fuel for steam raising. It was stated that four vessels of the Hamburg-American line had already been equipped for burning oil, with the result that the consumption for twenty-four hours was about 32 tons of fuel oil, as compared with 43 tons of coal. In an Austrian-Lloyd steamer of 9,000 horse power 23½ tons of oil replaced 43 tons of Welsh coal, or 74.7 tons of Dalmatian coal. The Holden burner described by the author appears to be capable of a very varied adoption, and, further, it can be applied for the consumption of oil in connection with solid fuel. With this apparatus an equivalent evaporation of 15.5 pounds of water per pound of oil has been secured, but it must be noted that to burn oil satisfactorily, the suitable design of the furnace is equally important with the proper design of the burner.

A somewhat kindred subject was brought before the meeting by Mr. R. Pearson, who read a paper on "The Discovery of Natural Gas in Sussex." The presence of natural gas in that county has been known for many years, but it is only quite lately that this form of combustible has been utilized for light and power. The Heathfield Station on the London, Brighton & South Coast Railway is already lighted by means of natural gas, which is also employed for lighting and heating purposes in many houses at Heathfield. It has further been applied for driving gas engines in the same district. At present it is not definitely clear whether the gas fields of Sussex are of sufficient capacity and extent to revolutionize the character of this and adjoining counties. Mr. Pearson expressed the opinion that a good supply of gas at great pressure would be available, and stated that inquiries were already being made for land with underlying supplies of gas, with the object of establishing manufactories in Sussex. It is a well-known fact that iron is plentiful in the district, and if fuel can be provided at sufficiently low rates, there may be wonderful changes in a part of England now regarded as a stronghold of agriculture, and as a place in which people may escape, temporarily or permanently, from the busy hum of the metropolis.

Two or three papers read during the ensuing meeting dealt with the application of certain problems of physical science to mechanical engineering. One of these, by Mr. C. H. Wingfield, on "Permanent Set in Cast Iron Due to Small Stresses," was of considerable interest. The author showed that piston rings, each consisting of an inner and outer ring of uniform section, differed materially in the quality of their outward pressure per square inch of circumference, whereas by the formulæ generally published they should agree in this respect. Other experiments described by him made clear the fact that when springrings had been forced into circular gages, they suffered material permanent set during the first fifteen minutes. It was also found that a measurable degree of set was producible by merely squeezing a ring of this kind between the hands. The amount of spring in a cast-iron ring appears to be much greater than is generally realized. According to the author, a springring about 5¼ inches in diameter, and with its ends 1¼ inches apart, after deducting the permanent set, can be bent until they meet, and when released they spring back again to 1¼ inches apart. It is to be regretted that very little time was available for the discussion of this paper, and the same remark applies to a subsequent communication by Mr. E. G. Izod, on "The Brittleness of Steel."

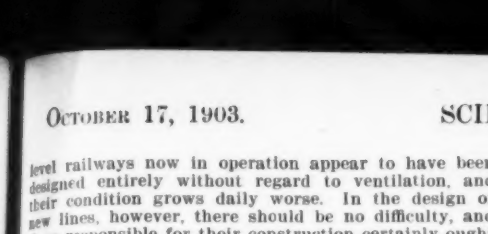
After other papers had been read upon "Experiments with Air Friction," "Single Phase Repulsion Motors," and "A New Form of Mirror Extensometer," Mr. J. W. Thomas brought before the meeting the subject of "Ventilation in Tube Railways," dealing chiefly with the physical conditions necessary for securing adequate ventilation in such systems. The author expressed the undoubtedly correct opinion that the forces due to the moving trains, and the natural heat of the subways, would be ample for the required object if properly directed. This is a view we have more than once expressed, and we are glad to find it has been clearly brought before the British Association. Mr. Thomas proposes a triple-station arrangement and his scheme will be understood from the following brief outline: If the three stations of the group be called A, B, and C, a down train traveling from A to B would draw air from the station A, and expel it in station B, and an up train traveling from C to B would draw air from station C and expel it in station B. Owing to the elasticity of air, the outlets for expelling the vitiated atmosphere must be situated not far from the points of greatest compression, and should begin in the center of each underground station, and end in the open air above the surface station. For a similar reason the fresh air intakes should be near the points where the sudden expansion of the air will take place. These points are just inside the ends of the tubes entered by the moving trains. Airtight doors should be fitted at the ends of the two tubes, and by closing these doors behind the last trains at night the fresh air brought into the end of the tube immediately beyond the doors would continue to act during the night, driving the foul air into the next station by natural ventilating pressure. By closing the doors after some of the trains as they left the stations, it is suggested that fresh air would be drawn into the tubes during the day time. This system does not seem to be entirely adequate for the purpose of effecting the ventilation of a tubular railway. One great difficulty on the lines already in operation is caused by intercommunication between the up and down tubes, and the only satisfactory arrangement would be the complete and absolute separation of each station into two parts, one for up and the other for down traffic. Then, by the suitable provision of doors, it would be possible to insure a complete and thorough renewal of the atmosphere along the whole line. As all the trains in each tube would move in one direction only it would be possible to provide for a regular current of air from a main inlet at one end, to a main outlet at the other, or to arrange for fresh air to be drawn in at some stations and ejected at others. Low

level railways now in operation appear to have been designed entirely without regard to ventilation, and their condition grows daily worse. In the design of new lines, however, there should be no difficulty, and those responsible for their construction certainly ought to take the advice of ventilating experts, so that the state of things existing in the City and South London and Central London Railways may not be reproduced.

We have not attempted to refer to all the papers presented before the recent meeting of the British Association, but it will be gathered that some of the most important departments of engineering work were practically ignored. It is true that many useful papers were read, and that those relative to traffic problems were especially valuable. Nevertheless, the success of the engineering section might have been far greater if the subjects for discussion had been more varied. Another feature tending to detract from the usefulness of the session was to be found in the excessive number of papers crowded into each sitting, with the result that little or no time was available for discussion of the subjects opened. Consequently, members became wearied by the reading of paper after paper; and finding practically no opportunity of taking part in the proceedings, or of profiting by listening to the expression of varied opinions upon the problems brought forward, they had little inducement to continue in attendance. The fact that many of the papers were read to meetings comprising no more than five or six members is conclusive evidence that the organization of the sections was far from satisfactory. Those upon whom devolves the arrangement of the proceedings would do well to remember that the complete discussion of one subject is of far greater value than the accumulation of numerous papers, which have to be hurried through owing to the limited time at disposal, and so do not receive anything like the attention that they may frequently deserve. On the whole, while fully recognizing the merits of many papers read and discussed, it must be said that this year's meeting of the engineering section has been somewhat disappointing to those who look upon the British Asscciation meeting as a function at which the views of the leading scientists in the country will be expressed for the advantage of the nation at large.—The Builder.

THE JENATZY ELECTRICAL TRANSMISSION.

THE following is a description of an invention recently patented by Jenatzy, the winner of the Gordon Bennett race. Its object is the progressive transmission of the power of the motor to the wheels of the automobile without the intervention of change speed gears. It furnishes a very flexible transmission of great smoothness, permitting of an exact balance between the power of the motor and the work required of it to maintain the vehicle at any desired speed over



THE JENATZY ELECTRIC CLUTCH.

any road within the power of the motor. The transmission, while very efficient, is also elastic and protects the motor to a very large extent from the shocks and reverberations of the road.

The main feature of the invention is characterized by the establishing of a magnetic clutching between the motor shaft and the shaft driving the wheels, the necessary energy being furnished to a field magnet ring by the current of a dynamo driven by the motor.

The diagram shows an arrangement of the invention.

On the shaft *A* of the engine *B* is placed instead of the ordinary flywheel a field magnet system *C* carried by a cross-bar *D* of suitable material. In the field magnet *C* is placed an armature *E*, suitably wound and supported on a shaft *F*, which connects directly to the driving wheels *G*, of the vehicle by a bevel gear *H* or other suitable arrangement. The current of the dynamo *I*, driven by the engine *B*, is led to the coils of the magnet *C* by the ring collectors *J*, on which are the brushes *K*, which are connected to the poles of the source of the electricity *I*. One of these brushes is directly connected to the dynamo pole and the other to the opposite pole through a switch *L* and a rheostat controlled by the operator.

It is easy from this description to understand the operation of the apparatus. When the motor is running and the field circuit is open the motor turns the field without driving the carriage. When the driver closes the circuit with the interpolation of the resistance *M*, a magnetic field is established in the magnet *C*. The armature *E* starts and the carriage moves very slowly on account of the weakness of the field. As the driver gradually cuts out the resistance *M* the field becomes stronger and the armature *E* approaches more and more nearly the speed of the field magnet *C*, and the speed of the vehicle will be a maximum when the field is saturated. Similarly, as the field is weakened by the interposition of resistance at *M* the speed of the armature and consequently that of the vehicle will diminish until, finally, when the circuit is opened, its own inertia will be the only thing to keep it in motion and it will gradually come to a stop.

It would seem that a combination gasoline electric system of this kind would be entirely independent of any patents on gasoline propulsion, such as the Selden, because the car is driven by an electric motor instead of a gas engine.

Such a system does away entirely with all change speed gears, and it is probable that the heavy losses entailed by their use would more than compensate for the transformation of the energy from mechanical to electric and back again. Furthermore, such a transmission would be perfectly smooth, noiseless, and would automatically adjust itself to any varying load. A somewhat similar system is the Germain, which has been worked out in Belgium.

There are great possibilities in these combination systems, and they may eventually supersede the straight gasoline engine drive, as the efficiency is higher and the one great difficulty of the gasoline engine is entirely eliminated, namely, its greatly varying efficiency under varying loads. With a system such as this a smaller engine can be used and worked at its best efficiency under widely varying loads.—Automobile Review.

AN ENGLISH EDISON BATTERY TEST.

THIS report was made by Mr. W. Hibbert on tests in England of the Edison storage battery.

The standard automobile cell is of rectangular shape. It stands 13 inches high (over all), measures 5.1x3.5 inches horizontally, and weighs 17.8 pounds. It contains 14 positive and 14 negative plates. Each plate

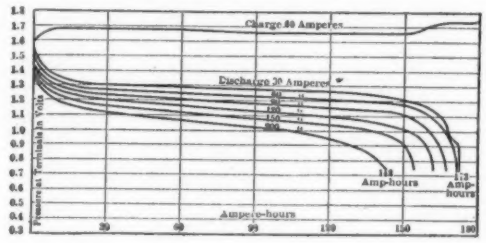


FIG. 1.

is made of sheet steel, nickel-plated, punched with 18 rectangular holes. In each of these holes is inserted a flat pouch or pocket containing the active material. The walls of these pockets are perforated by exceedingly fine, short slots, through which the liquid can penetrate. Thus the current can easily pass to and from the active material contained in the pocket.

Both positive and negative plates are alike, except in respect of the active material. The pockets in the negative plate contain finely-divided iron; those in the positive contain peroxide of nickel. The liquid is a 20-per-cent solution of potash. This suffers no change during the action of the cell, except the loss of a small quantity of water, which is decomposed while the cell is being charged. A small quantity of electrolyte suffices as it acts merely as an electrolytic conductor and not as an active material in the ordinary sense. The plates may therefore be fixed very near each other, for the narrow intervening space allows an adequate supply of potash solution.

The proximity of the plates does not apparently involve danger of short-circuiting. The plates are thin, but being made of steel, their rigidity is exceptionally good. Mechanical stability is further assured by vulcanized rubber separators, the whole forming a compact mass, calculated to resist all the ordinary mechanical shocks it is likely to undergo.

The only special mechanical difficulty which seemed probable was the chance that the gases evolved during a "charge" might eject some of the active material from the pockets. During the test, therefore, the pockets were watched carefully, especially during very heavy charges, but without any evidence of loss.

The cell is sealed in its steel case. Two stout connecting pins (from the positive and negative plates respectively) come through liquid-tight bushings of vulcanized rubber. These pins are made slightly conical, as are also the connectors, which fit on them, and the mechanical finish and easy grip of this terminal add to the value of the battery. On the top of the case there are also a spring stopper, with rubber flange, covering the hole by which the electrolyte is introduced, or distilled water added from time to time, and a vent hole guarded by a gravity valve. This latter provides for the escape of the gas evolved during charge. The hole and valve are covered by a gauze nipple, which prevents escape of spray while allowing gas to pass. Acting on the principle of Sir Humphry Davy's safety lamp, the same gauze further prevents any chance of explosion should a flame be brought near to the exit.

The E. M. F. is 1.33 volts. The internal resistance

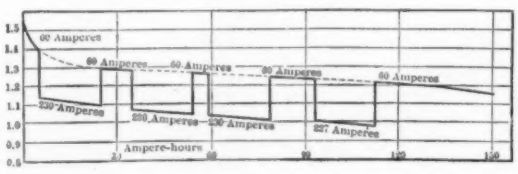


FIG. 2.

is 0.0013 ohm. The output at 60 amperes is 210 watt-hours, or at the rate of 11.8 watt-hours per pound of cell. The discharging value at high rates of discharge rises to many times the normal. The cell suffers no appreciable polarization, and therefore recovers its normal voltage almost instantaneously when the current returns to an ordinary value.

In the accompanying curves, Fig. 1 shows the pressure during discharge. Each line corresponds to a constant current, the discharge rates varying from 30 to 200 amperes. This last is a high rate for a cell of this size, but the experiment proved that the cell could stand it without injury. It took the succeeding charge in an excellent way, and yielded the 30 ampere curve immediately afterward. At 120 amperes the output was 91 per cent of the maximum. Even at 200 amperes the capacity (ampere-hours) is 82 per cent of the maximum.

In Fig. 2 are given the results of one out of many experiments, intended to test the flexibility of the cell. The standard cell was discharged, starting at 60 amperes. After a time (5 minutes) the current was suddenly increased to 230 amperes. A little later the current was reduced again to 60, and so on, as shown by the curve. The cell yielded this great current for short intervals and recovered almost instantaneously. It does not appear to be injured in any way, and subsequent charging and discharging seemed to be quite normal.

An important point in traction cells is the rate at which they can be charged. Experiments on this point demonstrated that the Edison cell will absorb 70 to 75 per cent of its full charge in one hour. The cell charged for one hour only, at the excess rate of 175 amperes. It was then discharged and gave data for the curve. This shows that it absorbed and could deliver 124 ampere-hours out of the 175 put into it at this very great rate.

After three months' work with very many charges and discharges, the capacity of the cells remains the same as at the beginning. It has neither increased nor diminished. Examination of the plates, after three months' work, does not indicate any signs of corrosion. The plates are as even in surface and as rigid in strength as at the beginning.

The standard cell was sent to England from America via Paris, and therefore underwent two trans-shipments, together with many loadings and unloadings, and journeys by rail and road. This long and varied journey was made in its ordinary working conditions, the plates and fittings in the case fixed as in use. The only difference was that the cell traveled without the liquid, so that the plates were more or less exposed to air.

On its arrival, having in it no liquid except that which had trickled off the plates to the bottom, it was joined to a voltmeter and gave 1.33 volts. The full quantity of electrolyte was then put in, and the cell given a first charge and discharge. The output following the first charge was 174 ampere-hours, a figure identical with that obtained after further treatments.

THE COW AS AN IVORY PRODUCER.

NAPKIN rings, hair combs, walking-stick knobs, brush backs and handles, cigarette cases and holders, and a variety of other small objects are now being made of milk. It appears that much of the cheap imitation ivory now in the trade comes from the cow. There are even alleged pearls worn in earrings, or in other kinds of so-called fancy jewelry, which are literally drops of condensed milk. A nobleman owning immense estates and large farms in the Loiret Department has set up a factory for carrying on this new industry. His cows produce some 200 gallons of milk a day, two-thirds of which is sent to Paris in the season. But in summer the demand falls off, while the cows continue to yield the usual quantity. Hence, the ingenious nobleman's new departure. The caseine obtained from the milk is converted, under great pressure, into a ductile substance called "lactite," the possible uses of which seem to be unlimited. It is this sub-product of milk which is replacing celluloid in the market as imitation ivory. Moreover, lactite can be employed, it appears, in coloring processes for textiles, and for the treatment of wines, notably for the operation called "collage." Cabinetmakers also use it for veneering furniture, and potters manufacture with it imitation earthenware. Glove makers have just successfully experimented with lactite for producing the glace surface on kid. Tire manufacturers have hopes of employing it instead of gutta-percha. An American inventor affirms that a powder can be extracted therefrom which is just as good as snuff, and a great deal better; but the French nobleman in question has not yet gone in for that particular branch of the new industry on his Loiret estates.—Paris Correspondent, London Telegraph.

ENGLISH EXPERIMENTS IN COAL-DUST EXPLOSIONS.

MR. HALL, inspector of mines, experimented for the English Commission appointed to inquire into explosions from coal dust in mines. He proved that when a gunpowder shot was fired in a pit 50 yards deep and 7 feet in diameter and ventilated by an air-current of 750 cubic feet per minute—that 25 minutes after coal dust had been thrown into the pit and only the finest dust remained in suspension—that under these conditions a very violent explosion might result and flame be forced out of the shaft to a height of 60 feet. The photographs of the explosions, as they appeared above the pit top, showed that when only the fine dust was in suspension the smoke and dust were less dense, and the flame more intense. Experiments were also made by firing shots in the pit 30 to 45 minutes after the previous explosion without adding any additional dust, and the resultant explosions shot up 15 to 50 feet above the pit top.

Fortunately a record was kept during these experiments of the state of the weather, and Mr. Hall reports, that "the experiments occupied 12 days, the weather throughout being most favorable, and on several days there was an unusual difference between the wet and dry bulb thermometers, showing the atmosphere to be very dry." The object of this note is clearly to point out that the coal dust was dry, and the air also dry, and therefore both were in the most favorable condition for demonstrating the explosibility of coal dust. We must, however, probe a little deeper to get at the facts which are of the first value in this investigation; we shall be astonished to find that the water content of the air varied during these days from 3.6 grains to 6.2 grains per cubic foot, and on one day it was within 14 per cent of absolute saturation. We also find that on the 8th day of July, 1903, a charge of 1½ hundredweights of dust was thrown into the pit, and 3 minutes afterward a charge of 10 ounces of ammonite was fired without causing an explosion; 11 minutes after this a charge of 8 ounces of roburite was also fired without adding any more dust, and no ex-

plosion resulted; and then 25 minutes after the last shot a charge of 1½ pounds of gunpowder was fired again, without adding fresh coal dust, with the result that a very violent explosion occurred and flame shot up 60 feet above the pit top. This experiment proved that 39 minutes after dust was put in, the two shots had been fired, each of which would blow a considerable quantity of dust out of the pit, and when the air was carrying its greatest load of water of any day during the experiments, viz., 6.2 grains per cubic foot, the most violent explosions might occur. Nearly all the explosions on this particular day are reported as "very violent." It is unfortunate for a continuance of this argument that experiments were not made with similar dusts on days when the water content was at its lowest, as well as when at its highest or *vice versa;* still we may carefully note that on the 23d of June, when rain was falling nearly all day, and the thermometer heats were low, viz., 54 and 52, the water content was 4.1 grains per cubic foot, or only 0.6 grain under absolute saturation, very violent explosions occurred, forcing the flame 60 feet above the pit top.

In reference to these experiments Mr. Hall remarks that "mines which are naturally of a dry and dusty character cannot be artificially damped so as to render gunpowder safe, and it is deserving of consideration and experiment to test whether a coal-dust explosion would be stopped in its course by a certain length of roadway being constantly kept in a wet condition. Personally, I think such a plan would not prove effective in consequence of what may be termed the pioneering cloud of dust which precedes the flame." As a further proof that a pioneering cloud of dust is unnecessary we may note one of Prof. Dixon's remarks (British Coal-Dust Commission) regarding the Radstock explosion, viz., that the path traveled by the flame was not "dusty" in the sense in which that word is ordinarily used in mines. The necessity of a pioneering cloud of dust is, therefore, as quoted above and as proved by Mr. Hall's own experiments, a negligible factor in the initiation of coal-dust explosions.—Mines and Minerals.

MEKARSKI SYSTEM OF COMPRESSED-AIR LOCOMOTIVES AS USED ON SUBURBAN LINES IN PARIS.*

By Our PARIS CORRESPONDENT.

PROBABLY no other city has as many different systems of traction for city and suburban lines as Paris, and this may be easily explained by the fact that the trolley is not allowed within the city limits, and thus the traction problem became somewhat difficult. The electric tramways were obliged to use expensive systems, such as underground conduit, surface contact, or accumulators. Under these conditions they have been closely rivaled by the compressed-air and steam systems, and compressed-air motors have been adopted on as many as seven of the most important lines, using the Mekarski system, which has been lately introduced and has proved very successful in practice. The Mekarski locomotive is used on the Paris-Arpajon line to draw trains made up of four or five cars, running fifteen miles into the suburbs. The locomotives carry a set of storage cylinders into which the air is compressed at the station. Mekarski is probably the first to make the compressed-air locomotive practicable, having solved the various problems connected with it in an ingenious and simple manner, having devised a pressure-regulator as well as a practical method of heating the air for the motor.

The air which is contained in the storage cylinders decreases in pressure as it is used, and it is necessary to provide a method of regulation, so as to keep it at the desired pressure in the motor cylinders. The regulator is shown in Fig. 1. The air supply enters from below and passes into the chamber, *C*, and thence to the motor. To do so it must pass by the valve, *s*, which is mounted on a rod carrying at the top a flat circular plate, *P*. The latter presses against a rubber diaphragm which is fastened above it and rests against the roof of the chamber, *C;* the roof is pierced with holes and forms the bottom of a small hydraulic press in which the desired pressure is maintained by forcing down the plunger, *K* (which is filled with air), by means of the screw and hand-wheel. When the screw is turned, forcing down the hydraulic press, the water it contains passes through the holes in the bottom and pushes against the diaphragm, which in turn forces down the plate, *P*, and opens the valve below. The air then passes out into the chamber, *C*, and thence to the motor. If the pressure on the hydraulic press is diminished the compressed air contained in the chamber, *C*, pushes up the plate and closes the admission valve. Owing to the use of the rubber diaphragm the regulator is sensitive in its action and easily operated, and when once the hydraulic press is regulated for a given supply, the air is always kept at the right pressure in the motor, regardless of the varying pressure in the storage cylinders.

Besides regulating the pressure, it is also necessary to heat the air before it passes into the cylinders of the engine, otherwise the system would be impracticable and its efficiency would be reduced almost to nothing. If we suppose the temperature of the air in the reservoir, which is at the normal, or 15 deg. C., to enter the motor at a pressure of 6 atmospheres, it then expands from 6 down to 1 atmosphere. Supposing the air before entering to be at various temperatures, 15, 100, 150, 200, and 300 deg., we find by applying the proper formula for the energy furnished by 1 kilogramme of air that the expansion will produce a corresponding cooling of —102 deg., —52, —22, +8, and +67 deg. The work in kilogramme-meters corresponding to this fall of temperature is 8,354, 10,853, 12,281, 13,709, and 16,636, and by taking the work at 15 deg. as unity we find the following ratios: 1.0, 1.3, 1.5, 1.6, 2.0; that is, the work performed by the air which has been heated to 300 deg. is twice that corresponding to 15 deg. Thus the value of previously heating the air is closely indicated.

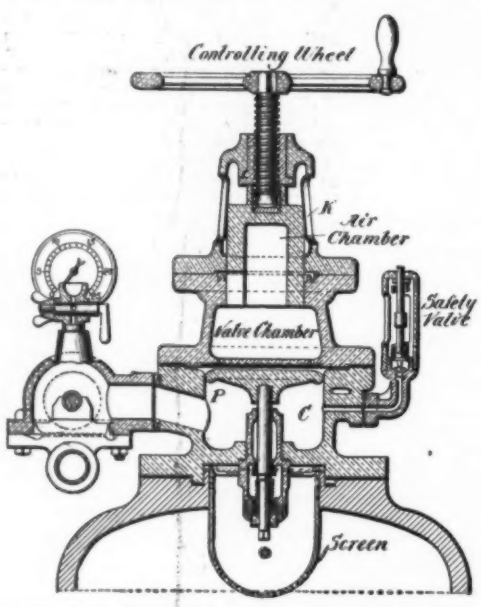
Another reason of a different order is that if the air has not been heated the great degree of cold produced by the expansion causes the water vapor which it carries to be transformed into small particles of ice which stop the motor. This was for a long time one of the main difficulties in the construction of compressed-air locomotives. The quantity of heat absorbed by the preliminary heating is very small and is but 51 heat units per kilogramme of air, which is the heat obtained from 10 grammes of coal. There is, however, a certain limit to the heating of air, as the best lubricating oils commence to vaporize at 270 deg. and this limit must not be approached too nearly.

A second consideration of equal importance is that a much better effect can be obtained by heating the air in the cylinder during its expansion, and in this case the results are different. Calculation shows in fact that if the air which has been previously heated as above is not allowed to fall in temperature during the expansion, but is kept by artificial means at the same point, the work obtained from a kilogramme of air is 15,110, 19,560, 22,190, 24,810, and 30,060 kilogramme-meters (corresponding to the above cases), giving the ratios 1.81, 2.34, 2.66, 2.97, 3.60. Thus, taking as unity the work performed by the expansion of a kilogramme of non-heated air from 6 down to 1 atmosphere, this work will be increased to 2 if the air has been heated to 300 deg. before going to the motor, or to 3.6 if the temperature in the cylinder is not allowed to fall. In practice it is impossible to use an atomized spray of hot water in the cylinder, as in the air-compressors, as the apparatus is too complicated for use on a locomotive, and a hot-water jacket would not give up its heat quickly enough, owing to the poor conductivity of the air.

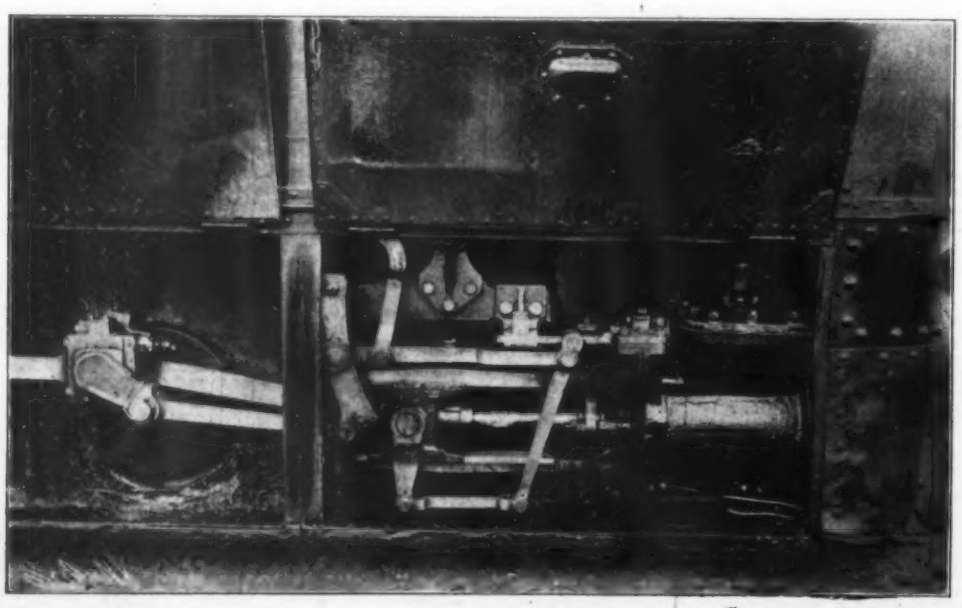
In the Mekarski system this difficulty is overcome by the use of a simple device known as the *bouillotte*. Upon the locomotive is placed a reservoir which contains water which has been heated at the station to 160 deg. C. under pressure. The air is made to pass through the water in a mixing chamber and is thus heated and also mixed with water vapor at a tension corresponding to its temperature. The air passing to the motor cylinders is thus charged with steam and should the temperature lower, the steam will condense and give up its latent heat of vaporization, supplying heat to the air and enabling it to work under better conditions. In this way the passage of the air through the water accomplishes two distinct results: first, it heats the air before sending it to the motor; and second, it provides a means of heating it during the expansion in the cylinder. In the latter case, seeing that the temperature is not kept exactly constant, the work performed is somewhat less than if it were so, and is, in fact, the arithmetical mean of the above two sets of figures.

The general appearance of the locomotive used on the Paris-Arpajon line is seen in the engraving given herewith. The storage cylinders are mounted in the main body of the locomotive, running longitudinally between the two platforms, and may be observed through one of the windows, which is removed. There are eight of these cylinders, superposed in four pairs. They are tested at 80 atmospheres and contain a supply of 1,170 pounds. The cylinders are charged while upon the locomotives from an air compressor set at the station. The *bouillotte* with its regulator is mounted at the front of the platform and there is an identical set in the front and rear so as to avoid turning the locomotive. The *bouillotte* is supplied with hot water while *en route* by two reservoirs

LOCOMOTIVE WITH ITS SIDE PANELS RAISED TO SHOW MECHANISM.



SECTION THROUGH THE ENGINEER'S VALVE.



DETAILS OF THE MOTOR.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

which contain hot water at high pressure, mounted crosswise under the platforms. The end of one of these cylinders will be observed below. The front cylinder carries 80 gallons and the rear 50 gallons. At the station a set of small boilers is used specially for charging the reservoirs, and they supply water at a temperature of 190 deg. C., which corresponds to a pressure of 12 atmospheres.

The mechanism is all located at the exterior where it is easily accessible. It is protected by a set of hinged panels which can be raised and held by chains in order to clean and inspect the running parts. A motor is mounted on each side of the locomotive and these are divided off from the middle part by a vertical partition. One of the views shows the motor in detail. The movement is transmitted by the piston to the forward axle and from thence by a connecting rod to the two rear axles, as in a locomotive, the wheels being inside the vertical partition. The motors have a 6.4-inch cylinder and 11-inch stroke, with a slide-valve of the Walschaert pattern. The admission of air may be varied during 21 to 78 per cent of the stroke; in general it is regulated at 30 per cent. This is carried out by a lever moving over a sector at the right of the engineer. The exhaust from the motor cylinders escapes into a muffling chamber composed of four concentric tubes. In this way the steam is condensed and there is no noise or escape of steam from the locomotive. Although a number of valves are necessary to make connection between the different parts, in practice the maneuver is simple, and the engineer, after opening the valve of the storage cylinders and one of the hot-water tanks and regulating the cut-off of the motor, is only obliged to operate the hand-wheel of the regulator and the lever of the air-brake. The Arpajon line has at present five of these locomotives for the suburban trains. The total weight is 16.5 tons when empty, and when complete with the air and water supply it weighs 18 tons.

TROPICAL TREES IN CALIFORNIA.

By CHARLES F. HOLDER.

ONE of the charms of Southern California to the visitor especially in winter, is the profusion of seemingly tropical verdure which everywhere greets the eye; yet Southern California is by no means a tropical country. The mercury stands at 2 or 3 deg. below freezing several nights every winter, and ice is often seen in the morning in certain localities; but the moment the sun is out semi-tropic conditions prevail again, and strange to relate, little or no damage is done by the cold.

In all the cities and towns of the State the palms particularly attract attention, and their size indicates that Southern California has not had in a century sufficient cold to injure them, and that they will readily withstand a temperature of 26 deg. Pasadena, perhaps, gives the most pleasing impression of tropical conditions, many of its streets being lined with palms, and the gardens filled with numerous varieties of these trees. The most familiar form is the fan palm *Washingtonia*, shown in the accompanying photographs. When large they are stately and beautiful trees, and Pasadena, 50 years from to-day, will be well supplied with them. They are slow growers, averaging a foot a year under very favorable conditions, but when deprived of water they grow slowly. In the city mentioned there are a number of palms 30 or 40 feet in height; and at the old mission of San Gabriel some magnificent specimens are seen. Fig. 1 shows the effect of young palms in a street in Pasadena, these being about 18 or 20 years old. Larger palms on the ranch of Mr. J. Bakewell Phillips, on Magnolia Drive, are shown in Fig. 2. In the latter instance the trees have not been trimmed, the leaves being allowed to droop, almost covering the trunk. These palms are perhaps 30 years old and have had an abundance of water. In Los Angeles, San Diego, Santa Barbara, and especially San Fernando, there are lofty examples of this beautiful, indeed majestic, tree. This palm is particularly interesting from the fact that it is indigenous to California, being found in a range of mountains facing the famous Salton Sea. How the palms came in this locality no one knows, but they are growing in several cañons which reach down to the desert, and in summer one of the hottest places in the United States. To the east is the great depression, nearly 300 feet below sea-level, and beyond the great Californian desert.

The *Phoenix canariensis*, or date palm, in its several species, is very common in Southern California; its graceful leaves and ponderous trunk being seen in almost every dooryard or garden, while the Alexandra palm, *Erythea*, *Areca*, and many more flourish and add to the tropical appearance of the country.

FIG. 1.—STREET IN PASADENA, CALIFORNIA.

THE MOSQUITO PLANT.

AN interesting controversy has been going on in the columns of the London Times over the supposed virtues of the "mosquito plant," the name given to a variety of basil, the *Ocimum viride*.

Last April Capt. Larymore, the British resident in Northern Nigeria, published a letter in which he asserted that by placing two or three pots of "mosquito plant" in each room of a house, and others along the windward side of the veranda, the place could be kept practically free from mosquitos. He described an experiment he had made, which showed that a mosquito inclosed within a leaf of the plant became stupefied, and he added that an infusion of the leaves of the plant was held by the natives of Northern Nigeria to be more efficacious than quinine as a remedy for malarial fever. Capt. Larymore suggested that the plant should be used in barracks in India.

Sir George Birdwood, the well-known naturalist, wrote a day or two afterward that allied basil plants had been known from time immemorial as a defense against mosquitos and as a prophylactic in malarial districts throughout India. He related how, when the Victoria Gardens were being constructed in Bombay, the men employed in the work were so pestered by mosquitos and suffered so greatly from malaria that, at the suggestion of the Hindu manager, the whole boundary of the gardens was planted with "holy basil" and any other basils which were at hand, with the result that the plague of mosquitos was at once abated and the malarial fever disappeared from the gardeners and others at work on the grounds.

Capt. Larymore took with him to England a growing specimen of the plant, which he gave to the authorities at Kew Gardens, the great botanical establishment near London. The officials there were much interested in the captain's statements, but they are now convinced that there was no foundation for them. The director of Kew Gardens, Sir William Thiselton-Dyer, wrote to the London Times on July 24, inclosing a report made to the governor of Sierra Leone by Dr. Prout, the principal medical officer of the colony. Dr. Prout gave

FIG. 2.—PALMS ON MAGNOLIA DRIVE.

lengthy details of experiments with a dozen mosquitos and the "mosquito plant."

These experiments failed utterly to show that the plant had any effect in driving away the insects. Sir William Thiselton-Dyer, in his introductory letter, made some rather sarcastic observations on "easy empirical" remedies, and the London Times was apparently convinced that Capt. Larymore and Sir George Birdwood were mistaken in their assertions, for it printed a leading article in which it declared that the "mosquito plant" has been shown to be "utterly useless."

Since then both Capt. Larymore and Sir George Birdwood have written to the Times declining to withdraw their statements as to the efficacy of the basil. Both pointed out that experiments with single pots of the plant and a few mosquitos could not be regarded as conclusive, and Sir George Birdwood said the real question was the weight of Capt. Larymore's practical experience against Dr. Prout's experiments. In a letter dated August 2, Capt. Larymore said:

"I think it unfortunate that the superficial experiments with a dozen mosquitos, which were conducted in Sierra Lecne, should have been accepted as conclusive evidence that the plant in question does not possess the properties ascribed to it.

"1. The plants employed may possibly not have been the same ocimum used and referred to by me.

"2. They may not have recovered after transplanting—mine were three to four months regaining their full foliage.

"3. The well-known powerful smell of ripe bananas may have negatived the scent of the plant in so small a space as the mosquito net cages mentioned.

"Natives from time immemorial have held that the plant does possess the properties I have ascribed to it, and the original cause of its becoming sacred in India, where it is still worshiped, was doubtless due to this fact.

"I must again repeat that the particular ocimum given me by the natives in Northern Nigeria does possess the power of driving away mosquitos, especially a healthy plant with its leaves bruised. My wife, who was with me, invariably used the leaves at night under open-worked stockings to protect her ankles, and at dinner the complete immunity enjoyed by her was very obvious indeed. In any case, I shall always make a point of having a hedge of the plant, if possible, in every garden I own in the tropics, and can only recommend those who are anxious and willing to add to (not necessarily take from) the security of mosquito netting and quinine, to do likewise."

Increased Emigration from Italy to the United States.—The disastrous effects of the failure of the cocoon crop of Piedmont, together with the further bad effects of the frosts and prolonged rains on the wheat, grape, and other crops of the province, have been exceedingly discouraging to the peasants, and the prediction is made that the coming year will witness a great increase, from this portion of Italy, in the emigration to the United States.—Pietro Cuneo, Consul at Turin.

INDUSTRIAL SCHOOLS IN GERMANY.

THERE are 287 industrial schools in Saxony. The population of the kingdom is 4,202,216, or one industrial school to every 14,641 people. The schools are divided into the following classes:

I. Advanced industrial schools (Höhere gewerbliche Schulen).

2. Special industrial schools (Gewerbliche Fachschulen).

3. Industrial schools for drawing and painting (Zeichen und Malschulen).

4. Industrial schools for women, girls, and children (Gewerbliche Lehranstalten für Frauen, Madchen, und Kinder).

5. Industrial primary or continuation schools (Gewerbliche Fortbildungsschulen).

ADVANCED INDUSTRIAL SCHOOLS.

There are 12 schools of this class in Saxony, located in the following cities: Chemnitz, Plauen, Hainichen, Dresden, Mittweida, Zwickau, Leipzig, Limbach, Bautzen.

The following curriculum of the advanced industrial school in Chemnitz not only speaks for itself, but is a fair example by which to judge the others. It is divided into five distinct minor schools known as the industrial academy, architecture, machine construction, dyeing, and industrial drawing departments. The industrial academy furnishes four courses—namely, for mechanics, chemists, architects, and electricians. The conditions of admission demand of the student sufficient education to be in possession of the certificate which entitles him to one year's service in the army. In addition to this he must show evidence that he has passed two years in some factory, acquiring practical knowledge of the branch in which he desires to theoretically perfect himself in the industrial school. The course of study for mechanics is as follows:

Required.—German language and literature, architectural drawing, mathematics, surveying, chemistry, mechanics, machine drawing and sketching, free-hand drawing, political economy, geometry, physics, metallurgy, machine architecture, machine construction.

Elective.—French, bookkeeping, weaving, English, beer brewing, sanitary arrangements, arithmetic, spinning.

The courses in the other departments are similar to this one.

SPECIAL INDUSTRIAL SCHOOLS.

There are about 150 of these schools in Saxony which are training young men to become expert workmen in the following trades and industries:

Trade or industry.	Number of schools.
Architects	11
Barbers	14
Tinmen	3
Brewers	1
Printers	3
Bookbinders	2
Decorators	1
Druggists	3
Butchers	1
Waiters	3
Tanners	1
Firemen	1
Wood carvers	6
Confectioners	1
Painters and varnishers	3
Musicians	26
Millers	1
Bead goods and dress trimmings	4
Locksmiths	7
Tailors	17
Chimney builders	1
Instruction in penmanship, etc.	4
Shoemakers	3
Toy makers	3
Lace makers	2
Paper hangers	1
Watchmakers	1
Weavers	23
Total	151

The following curriculum of the tin and metal industrial school in Aue, this consular district, is characteristic of what all these schools are: Arithmetic, drawing, physics, bookkeeping, geometry, sketching, mechanics, correspondence, German, modeling, chemistry.

The students devote twenty-eight hours each week to practical work in the tin and metal workshops of the school and factories of the city.

INDUSTRIAL SCHOOLS FOR DRAWING AND PAINTING.

There are 32 of these schools in Saxony, namely, 3 for painters in Dresden and 29 for industrial drawers, etc., in different cities in Saxony. Eighteen are connected with as many public schools throughout the country. The industrial drawing school in Eibenstock enjoys a good reputation. The sample exhibits of the school are exceptionally fine. The most exquisite designs in handmade lace curtains and bead and silk trimmings in ancient and modern fashions are so tastefully arranged that they can not fail in making a deep impression upon the apprentices, who see them almost daily.

INDUSTRIAL SCHOOLS FOR WOMEN, GIRLS, AND CHILDREN.

There are 21 of these schools in Saxony, namely, 19 for industrial education in general and 2 for lace making. One of the best schools of this class is in Schneeberg, this consular district.

INDUSTRIAL PRIMARY OR CONTINUATION SCHOOLS.

There are 44 of these schools in Saxony. They are intended to give boys and girls who have completed the public school course a chance to prepare themselves in a general way for some trade or particular branch of industry without the express intention of following the same.

In 1882 there were only 22 industrial schools in Saxony; to-day there are 287. This increase tells its own story.

REMARKS.

It is interesting to note that, in connection with the present school conflict in England, that country is closely watching the development of technical education in Germany. Only yesterday Lord Rosebery, in a letter to the board of directors appointed to carry out the plan of building a technical school in London similar to that in Berlin-Charlottenburg, gave prominence to the fact that ambitious young Englishmen desirous of obtaining a good technical education were obliged to attend the technical universities of America and Germany.* English industries suffered greatly in the past and were still suffering from the neglect to provide means for such training. The London Daily Mail, under date of June 22, contains an article about German industrial schools, which I consider well worth inserting here:

"The marvelous expansion of German trade—one of the notable achievements of the nineteenth century—is often referred to as attributable wholly to the fostering effect of bounties. In real truth, many factors have combined to produce the remarkable result.

"It is, of course, impossible to locate with certainty the actual effects of any given cause, but there can be but little doubt that the growth of many immense industries is traceable to the system of education that has directed all the available powers of scientific knowledge and research upon industrial problems.

"In Germany the university has in a measure been displaced from its position as crown of the educational edifice; or, rather, the classical foundations now share their supremacy with institutions of a more modern growth. The universities still maintain their old high rank as training schools in the humanities; but it is in the technical high schools that the keen business men with sound scientific knowledge are to-day receiving their training. Chemists and civil, mechanical, and mining engineers are receiving an educational training that brings them to the problems of business life with practical technical knowledge. The love of research is joined to the power of initiation—to the qualities, in short, that go to the building up of new industries and the constant expansion of old ones.

"The technical high schools are essentially modern institutions. They date back no farther than the nineteenth century, and their effectiveness is a matter of the last generation. Established as trade schools for the study of special subjects, they have widened their operations until they stand to-day for the application of scientific knowledge in all directions to the special requirements of commercial industry.

"Of these technical high schools there are now 9 in existence—at Aix la Chapelle, Berlin, Brunswick, Darmstadt, Dresden, Hanover, Karlsruhe, Munich, and Stuttgart—while 2 more are being added at Breslau and Danzig. . . . In these schools there are being trained at the present time nearly 15,000 students, receiving an education directly fitting them for participation in great industrial concerns in the capacity most calculated to promote expansion and progress. Many facts combine to prove the general opinion of the completeness and value of this training. In a period of thirty years the number of technical school students has been quadrupled. Out of a total of 15,000 students no less than one-sixth represent the youth of foreign nations†—a striking testimony to the excellence of the institutions.

"The course of training in these schools is not only severe, but it follows upon a severe preliminary education. No student is admitted as fully qualified who has not passed through the complete nine-year course of the classical gymnasium or 'real' school, in itself no mean accomplishment. In each of these cases a preliminary three-year course at a preparatory school has been taken, so that it would be impossible to enter the technical schools much before the age of 18 or 19, and, indeed, the age of admission is fixed at 18. In addition to the preliminary educational training, chemists are required to have worked for three years in an apothecary's establishment; architects must have completed a year of practical work at their profession; and engineering students must have passed the same period in mechanical work at some engineering factory. The usual course of training extends over a period of four years. Every conceivable branch of technical and practical science bearing upon the subject chosen comes within the range of study.

"The requirements of the various schools as to attendance upon lectures are elastic, and there is very little compulsion upon students. This is the more unnecessary, because, in the main, those who elect to undergo the course of training are aware of its severity, and are willing to devote themselves to work and study. Discipline, therefore, is easily maintained, though there are provisions for punishment ranging from reprimand to imprisonment and expulsion. For the rest, the life and habits of the students are much the same as at the universities. The year of enforced military service is either taken before or during the high-school training. This serves to defer the age at which the education of the German youth is completed, and he has usually attained the age of 24 or 25 before quitting the schools.

"The fees imposed at the technical high schools are extremely small. Although they vary, it is probable that the average annual expenditure for laboratory work, books, and examinations does not exceed $75. This, coupled with the fact that there are practically no endowments, entails a considerable charge upon the State both as a regular supplement to the yearly fees and for items for extraordinary expenditure such as the erection and equipment of buildings and laboratories and the provision for appliances.

"This cost, however, is cheerfully borne, as indeed it may well be, seeing that there is no department of national expenditure which can be so directly traced in remunerative results. In one direction alone—in the vast chemical industries of Germany—may be witnessed an actual creation, not merely a diversion, of trade amounting to many millions annually. Perhaps in no other industry in the world can the intimate connection between applied scientific knowledge and the growth of industries be so completely demonstrated."

INDUSTRIAL SCHOOLS IN OTHER GERMAN STATES.

In connection with the industrial schools of Saxony, it is also interesting to note the progress made in this direction by other German states of the empire.

In 1862 the city of Barmen sent a commission to Switzerland to study the industrial schools of that country. The result of this trip was the establishment of an industrial school in that city, with elementary and advanced departments. A pupil who desires to be admitted to the elementary class must be 12 years of age, able to read German fluently, and perform ordinary examples of arithmetic. During the winter months practical work is carried on in laboratories and workshops.

The Crefeld industrial school for textiles is one of the best in Germany. The object of the school is to prepare young men by practical and theoretical instruction to become managers and manufacturers as well as thorough experts in the textiles produced in Crefeld. The subjects taught are bookkeeping, spinning, weaving, and drawing. The course lasts two years. The city donated the lot and $35,000 toward erecting the school building. In Spemburg, Guben, and Kottbus similar schools for the weaving industry were established many years ago.

In 1879 an industrial school was established in Iserlohn for the metal and bronze industry of that city and vicinity. The pupil receives theoretical instruction at school and actual practice in factory and workshops. When these workshops were organized in connection with the school, some fifteen manufacturers of Iserlohn consented to furnish the necessary raw materials free of charge for a period of five years. This donation in reality amounted to $2,500.* It is also arranged that young men permanently employed in the factories may take evening courses in drawing and in the theory of manufacture.

In Heinsberg there is an industrial school which teaches young apprentices how to make baskets and how to braid and twist materials for making baskets. There are three masters, each having about twenty-five boys in charge. In Hildesheim, Siegen, Breslau, Sulza, Höxter, Idstein, and a large number of other small towns industrial schools have been founded for building and architectural purposes. The best schools, however, in this line are in Berlin and Holzmünden. They are for the most part under the supervision of and receive subventions from the state.

The following information about the industrial school at Bochum speaks for itself:

1. The school has for its primary object the education of master workmen for the iron, smelting, and machine industries of the district.

2. The course of instruction includes three semesters. The first semester is intended to be a sort of preparatory course, while the two following are devoted to the higher branches of metallurgy and construction.

3. The conditions of admission require that the candidate shall have spent four full years in practical work in some one of the many iron foundries of the neighborhood. No examination is necessary, but a certificate from the foreman of the factory is necessary to show that this time—the four years—was actually spent in a factory and that the pupil's behavior was satisfactory. He must be able to read and write—in fact, a knowledge of the subjects taught in the ordinary public school is required of the candidate.

4. Instruction is given on four week days during the forenoon and on two week days during the afternoon, so that plenty of time is left for excursions to the factories.

The Prussian State railways have also established industrial schools in Elberfeld, Berlin, Königsberg, Frankfort-on-the-Oder, Potsdam, Halberstadt, Breslau, and many other cities for the purpose of teaching apprentices every subject which has anything to do with the building or repairing of railway cars, etc. In every workshop connected with these schools there are 8 to 10 apprentices, so that the total number considerably exceeds 1,000. Each apprentice in these schools receives a remuneration of 20 cents a day, which is put out at interest until the end of the three years' apprenticeship, when he comes into possession of both principal and interest.

In Wurtemberg there are schools in Suttgart, Pforzheim, and vicinity for jewelry, musical instruments, and weaving. Many of them have well-equipped libraries. Heidesheim has a weaver's school. Such villages as Laichingen and Sindelfingen—names very little known outside of Wurtemberg—have schools for the linen industry. In Rottenburg there is a school for wood carvers; in Geislingen, a school for engravers; in Rottweil, one for ivory carving; while Gmünd, Heilbronn, and Bieberach have schools for the cheap gold and silver plated ware industries in those localities.

The government of Wurtemberg has done much to introduce and support new industries in certain parts of the country where old industries have died out. Some years ago, for example, the Royal Bureau for Commerce and Trade in Stuttgart decided to give financial assistance to the linen district of Alb, which had greatly suffered from Irish competition. The same was done with the handkerchief house industries in the district of Westerheim. It is the duty of this bureau for commerce and trade to keep in close touch with all the industrial schools in Wurtemberg. It is an institution which collects all sorts of information, data, etc., in regard to the needs of these schools and makes proposals concerning the establishment of new ones.

Industrial education in Baden is far advanced. There is a school in almost every city and village between Heidelberg and the Lake of Constance. Fully 20,000 apprentices are learning how to make clocks and cotton, woolen, and silk goods. Aside from the technical university of Karlsruhe, there is an industrial-art school which is attended by pupils from every part of Baden and these represent almost every trade in the

* See "Technical High School in England," published in Advance Sheets No. 1701 (July 20, 1908).

† In the spring of 1902, I wrote to the authorities of the different universities in Germany and ascertained that out of a total of 411 matriculated American students residing in Germany, only 58 were attending the technical universities.

* The State also furnished the needed machinery at a cost of $4,000.

country. In connection with the schools, there are workshops in which the young potter, painter, engraver, wood carver, lithographer, locksmith, blacksmith, cabinetmaker, etc., is getting all the practical knowledge necessary, so that at the end of three years he is master of some particular trade, not merely in name, but in reality.

Hessen can boast of the fact that there is not a single village, no matter how small, in the whole country which has not an industrial school of some kind. They are all under the direction of the minister of the interior. Workshops for actual practice are connected with most of the schools.

Bavaria is also well supplied with industrial schools. In connection with most of the courses there are classes for instruction in arithmetic, geometry, German, history, geography, physics, and chemistry. There are special industrial schools for the weaving industry in Passau, Münchberg, and Lambrecht. The last-mentioned school has an especially good reputation. It is not only intended for the cloth industry, but for linen, flannel, cotton goods, and carpet weaving. The manufacturers are in a position to obtain the most reliable information and statistics in regard to their branch of industry at any time.

This short outline will serve to show that great interest is taken in industrial education, and the time is not far distant when the whole empire will be thickly dotted with schools all equally as efficient as those in Saxony.

RÉSUMÉ.

The industrial schools in Germany, taking the empire as a whole, cover the following trades and industries: Weaving, finishing, cabinetmaking, basket making, metal, zinc, jewelry, lace, mechanics, porcelain, engravers, printing, blacksmiths, architects, shipbuilding, spinning, wood carving, masonry, paper, bronze, goldsmith, ivory carving, dress trimmings, brushes, shoemakers, lithographers, firemen, locksmiths, iron, fisheries, dyeing, sculpturing, clock making, sugar, tin, glass, silk, curtains, potters, straw weaving, musical instruments, machine technology, carpenters, painters.

ERNEST L. HARRIS,
U. S. Commercial Agent.

Eibenstock.

SUGAR SUPPLY OF THE UNITED STATES.*

By D. G. PURSE, President Savannah Board of Trade.

HISTORY informs us that "Indian salt," our cane sugar, was an article of trade in the market places of India 500 years before the dawn of Christianity, from whence the cultivation of the "sweet bamboo," from the juice of which it was manufactured, has belted the earth on tropical and semi-tropical lines and become, in propagation, seemingly, as indigenous as in India.

The ready adaptability of sugar cane to all tropical and semi-tropical climates has caused much controversy as to its origin, China claiming its cultivation in that country before the first lines of the Old Testament had been traced upon papyrus by the hand of Moses. Historians, however, discredit this claim of the Celestial Empire and with few exceptions, agree that in India the saccharine value of the "sweet bamboo," was first discovered and heralded over the East, China included.

That the value of sugar has been known and appreciated for its valuable and health-giving properties for centuries among the most enlightened nations, the elder Pliny, in the first century of the Christian era, wrote:

"Arabia produces sugar, but that of India is more renowned. It is a kind of honey collected from baboos. It is white as gum, breaks easily under the teeth and is very useful in medicine."

In the fifteenth and sixteenth centuries, Venetian and Portuguese enterprise spread the cultivation of sugar cane over the islands of the Mediterranean and the tropical islands and countries of the Atlantic, and from thence Europe and America drew their supply of sugar for 300 years.

With multiplied uses from increasing popularity in the dietaries of two continents, the demand for sugar was fast outstripping the supply and maintaining a price, with advancing tendency, that still classed its use among the luxuries of the table. Tropical indolence was inadequate to cope with this phase of the question by enlarging the areas of production and improving the methods of manufacture, though aided by European capital and directed in its employment by her superior intelligence.

Adverse conditions in the sources of sugar supply were accentuated at the opening of the nineteenth century by the inauguration of slave emancipation by Great Britain in her West Indian possessions, among the most prolific sources of production.

At the period to which we refer, France was at war with Europe. The beet was first being discussed as a possible source of sugar supply to supplement the product from the sugar cane. England, because of her vast resources by land and by sea, was most feared and most hated by Napoleon of all those allied to accomplish the defeat of his plans for making France a world power and advancing his own ambitious purpose.

Napoleon was quick to foresee that emancipation in the West Indies meant a lessened supply of sugar and a consequent relaxing of England's grip upon this important industry. He saw, too, that in advancing the beet to a rivalry with cane, as a producer of sugar, while he was weakening England's commercial supremacy, France was being freed from dependence upon same source for part of her sugar supply and an industry given life within her own borders that would, if successful, afford additional employment to her people and the soldiers returning home when the war was ended. Grander thought never inspired human genius, though conceived in the strategy of warlike purpose.

The French beet with which Napoleon determined to dethrone British sugar cane is not the best as we know it to-day, and it was not possible, therefore, for Napoleon to conceive the marvelous end to which he was building, and that within a century from the time he was laying the foundations for this new industry, it would so outstrip its rival, whose foundations seemed as deep-rooted as that of the everlasting hills, and that the world to-day, with an enormously increased sugar consumption, would be drawing from the product of the beet fully two-thirds of its consumptive requirements.

In fostering the cultivation of the beet which has so greatly increased the sugar-producing area of the world, Napoleon not only stimulated French enterprise in seeking to strike a blow at England's commercial supremacy, but, at the same time, conferred a blessing upon the human race by paving the way for a more general use of sugar where it had formerly been a luxury by reason of the popular belief that the tropics held a monopoly in sugar production that enabled the maintenance of prices that forbade its free use.

Your speaker stands to-day, almost central to the section of our own country that is profiting most by the foresight of Napoleon and contributing more largely each year to our disenthrallment from dependence upon foreign sources for the great bulk of our annual consumptive sugar supply; that is bringing new value to lands found suited for beet cultivation and establishing an industry that affords profitable and healthful employment to many thousands of our population. Your speaker has also the honor to come from the section of our common country where, for a hundred years, sugar cane flourished in tropical luxuriance, and where only now it is being realized that with more scientific study devoted to its cultivation and manufacture, Georgia, Florida, Alabama, and Mississippi led by Louisiana and Texas, will soon be able to join hands with the North and West in producing our entire consumptive supply of sugar without the importation of a pound from even our island possessions or Cuba.

It is our habit to associate sweetness with sugar, never power. So great is the insulating power of sugar upon the human palate, we cannot ordinarily separate our thoughts of it from the rich preparations of the housewife or the delicious creations of the confectioner, and, therefore, the difficulty of recognizing it to-day in its sterner aspect as a problem in diplomacy of international breadth, and a factor of gravest import in trade adjustments.

Only recently we had a forcible illustration of this latter proposition in the prompt action taken by the Secretary of the Treasury, at Washington, to bar out the importation of the bounty-fed beet sugar of Russia to this country, wherein it seemed for a while that grave complications might result in parting the long-existing friendship between the two countries, but which, however, has been amicably arranged; and, more recently, an utterance of the members of the Berlin Conference, now seeking to place the European beet sugar industry upon a safer commercial basis, classing Russian sugar as "bounty fed," has fully sustained Secretary Shaw in his contention with the Russian government.

It is not at all surprising that sugar holds such important place in commerce to-day, if we stop to reflect upon the enormous strides with which its consumption has increased over Europe and in this country, and the equally important fact that this growth in consumptive demand is so largely due to a more thorough knowledge of its value as a human food product, along with meats and the cereals in making muscle and bone, and as indispensable as either of them in every correctly constituted dietary.

In 1830, the United States had a population of 12,866,020; her importation of sugar (cane) amounted to 38,612 tons, in addition to 35,000 tons (cane) of domestic production, and she had a per capita consumption of 12.1 pounds.

In 1903, with official estimated population of 80,870,000 the United States imports 2,340,000 tons of sugar (cane and beet) with domestic production of 500,000 tons (cane and beet), with per capita consumption, estimated, 75.5 pounds.

Thus in 73 years, while our population has increased six fold, our imports of sugar have grown *sixty fold*, and the most remarkable part in the comparison is that each one of our vast population of to-day is charged with the consumption of six times as much sugar as each of his ancestors was able to digest seventy-three years ago. In this same period, domestic production of sugar has increased fifteen fold and the world's production ten fold.

In 1840, the sugar production of the world was 1,150,000 tons, of which only 50,000 tons were credited to the beet, one twenty-third of the production.

In 1902, the world's production of sugar amounted to 10 876,680 tons, of which 7,006,164 tons was beet sugar, being 64.32 per cent of the entire amount, one of the most wonderful growths in a century that will stand forth in history as the most remarkable in the annals of time for the great achievements conceived and consummated within its span, in every field, for the advancement of human progress on line with the highest intelligence and most rational economy in living.

Just as the discovery of mineral oil came at a time when whale and other animal oils were unable to meet the constantly increasing demand for them, and which condition threatened an unreasonable advance in price that would have operated as a bar to our progress, so beet sugar, at the appointed time, made its appearance to keep down the price of the product of the cane and make possible the enormous consumption, world wide, that has followed its entrance into the world's markets for sugar.

Beet sugar was favored by high prices in its infancy, that greatly stimulated production. In Germany, Russia and other foreign states, it has also been stimulated by bounties to build up an export trade for disposition of surplus over small home demands, and Great Britain and the United States have been, and are yet, the dumping grounds for this European surplus because their consumptive requirements absorb to-day about one-half the world's production.

But Great Britain, whose per capita of sugar consumption has reached one hundred pounds, has determined, after a half century of forbearance, that the methods of Continental Europe in bounty feeding beet sugar must cease, as the practice has proven destructive of the cane sugar interests of her colonial possessions, and that Berlin Conference, whose decrees are hereafter to regulate production of and traffic in beet sugar in Continental Europe upon the lines of fair and legitimate business principles as in their application to other industrial developments, is the outcome of British protest. The effect of this rearrangement upon the beet sugar industry is yet to be seen.

The bounty feeding system of Continental Europe as conducted in Germany, Russia *et al.*, has been as unjust to their own people as it has been unfair in the relation of these states to other countries not in the beet sugar alliance, and in every view prejudicial to a healthy state of international trade.

In Germany the cultivation of the beet for sugar production has been the most profitable branch of her agriculture, as protected by the bounty system which has made the German citizen pay twice as much for his sugar as the Englishman pays for the same sugar, after exportation to Great Britain, which explains why the British consumption stands at 100 pounds per capita, and the German at only 34 pounds per capita, with a larger population by 15,000,000 than Great Britain and producing 1,950,000 tons of sugar in 1902-3, nearly one-fifth of the world's entire production in the same period.

The Austro-Hungarian citizen suffers like the German, if not in a greater degree, and though the population of Austria-Hungary exceeds that of Great Britain, the largest buyer of her 1,000,000 tons annual sugar crop, the nation's per capita is less than 18 pounds.

In Switzerland, one of the smallest states of Europe, and not accredited as a sugar-producing country, consumption per capita exceeds sixty pounds—within four pounds of the per capita of the United States—ranking Switzerland as the third largest consumer of sugar per capita of population.

In France, until the first day of the present month (September), her citizens also had to bear their full share of the burden of bounty-fed sugar, as a national industry.

U. S. Consul B. H. Ridgley, writing from Nantes, France, under date of August 20, 1903, says:

"On September 1, 1903, the French people will be able to buy one of the great staple necessities of life very much cheaper than they have ever bought it before in France. The new law removing nearly 60 per cent of the customs and internal-revenue tax on sugar goes into effect on that day. Owing to the high price of sugar, France has heretofore imported from England a very considerable percentage of her fruit preserves. One result of the new law will probably be the largely increased manufacture of products of this nature in France and consequent loss of British exports." In the same letter Consul Ridgley says that another and immediate effect of the reduction in the price of sugar will be corresponding reduction in all the articles of which sugar is a constituent, public announcements to that end having already been made by French manufacturers.

One of the first results of cheap sugar in France will be shown in an increased per capita consumption, now 37 pounds, although France is credited with the production of 880,000 tons annually and a population little under that of Great Britain.

The prompt action of France has sounded the death knell of bounty fed sugar and the other states of Continental Europe must follow her lead, and, therefore, results in France will be followed very closely by Germany, Russia, and Austria-Hungary, which with France produce the bulk of the world's beet sugar supply.

There need be no fear for the beet sugar industry in passing through this new ordeal in a readjustment of methods for its future conduct.

The far-sighted legislation of France superseded really any necessity for a Berlin commission beyond registering the inevitable course of events. When the clouds roll by, the beet sugar industry of Europe will find itself upon a firmer commercial basis than it has ever previously enjoyed, and without any reduction in production, will have no export sugar. Her teeming millions athirst through decades for the "sweet salt" of India, but barred out from gratifying their cravings by prices inordinately swelled by extortionate taxation, at living prices will quickly advance per capita consumption and free commerce of a beet sugar surplus that for a decade has been the cause of increasing and incessant irritation in the diplomatic relations of the foremost enlightened countries of to-day. Great Britain felt forced to insist upon a Berlin Conference to re-adjust the world's commerce in beet sugar, and the United States has smarted under threats of reprisal in tariff legislation by Germany, because we discriminated against her bounty fed sugar exports to this country; and the recent ruling against a similar sugar importation from Russia is but an out-cropping of the universal irritation as it affected the United States directly.

Napoleon dealt with a beet in seeking to curtail British trade supremacy undeveloped by science, and showing only 5 per cent sugar content. The blow would have been ineffective except for the high price of cane sugar then prevailing.

One of the grandest triumphs of science gives us the same beet to-day, the equal of the cane in sugar content and in exceptional instances developing a greater richness.

During the evolution of the beet from a garden product to its present commanding position in the sugar industry, no progress has been made toward producing a cane higher in sugar content, which led a writer in the North American Review in 1899 to declare "that if one-tenth of the energy expended upon the beet had been devoted to the study of the sugar cane, the latter would long since have distanced its pudgy rival." But this has not been done, and for the present we must accept a situation that practically places the cane and the beet upon a common plane, from which the world's sugar must be drawn.

How long the beet product will continue to dominate this supply cannot be foreseen or if the product of the cane will even be able to assert its mastery again. These are the conditions that confront us to-day when we seek to meet the ever-increasing consumptive demand of the United States.

Our consumption for the year closing June 30, 1903,

* Read at Farmers' National Congress.

is placed at 2,725,746 tons of 2,240 pounds each, doubling our consumption in 16 years, showing 50 per cent increase per capita, and since 1900 an increase of 500,000 tons in consumption, or near 25 per cent in three years.

Owing to conditions existing in Europe and likely to continue for some time, results of almost certain increased consumption and possible curtailment of production, it will be wisest to leave out of our calculations the expectation of any importations from Continental Europe, and we must then draw our consumptive supply almost exclusively from Cuba, Hawaii, and Porto Rico, as well as we will have the sharp competition of England to boss in other directions.

Domestic production is now able to provide fully 500,000 tons of our consumptive needs, consisting of 300,000 tons cane, 195,000 tons beet, and 5,000 maple sugar. This may be said to constitute our basic supply.

In dealing with Cuba, it must be kept constantly in sight that the labor system that promised the greatest results to the island in cane cultivation exists no longer, and it will, therefore, be impossible with free tropical labor to do more than restore ante-bellum conditions that would make Cuba reasonably certain in producing 1,200,000 tons of sugar annually, 1,000,000 tons of which would seek this market.

We can only safely deal with this Cuban problem as a factor in our consumptive requirements by considering the utmost possibility under existing conditions, not what might be accomplished if there could be an infusion of Yankee energy into the tropical lethargy of the island's labor.

In the Hawaiian Islands, Doctor W. C. Stubbs, Director, Louisiana Experiment Sugar Station, who visited these islands in 1899 to study their agriculture as the representative of the United States Department of Agriculture, reported the full sugar area under cultivation, and that no material increase in sugar production could be expected from these islands in the future, but the production might be reduced by a derangement of the new character of labor upon which production depends.

If Dr. Stubbs is correct, 300,000 tons of sugar which would be marketed in this country, is, therefore, a full estimate of what can be relied upon for our consumptive supply from the Hawaiian Islands.

Porto Rico can safely be relied upon for 100,000 tons, taking as our basis for this assumption the annual production under our government of the island.

Should our consumptive requirements remain unchanged, a most improbable impossibility, we now have in sight 1,900,000 tons and would have the other cane sugar producing countries from which to obtain 825,746 tons, much more likely to be 1,000,000 tons another year, from growth of population without increase of the per capita consumption.

It is quite possible from the rapidity with which our consumptive demand has been swelling from year to year, out-running population, that in ten years our consumption will exceed 4,000,000 tons, and have reached Great Britain's per capita of 100 pounds; and with the per capita of Continental Europe materially advanced by cheap sugar, the world's production will be severely taxed to furnish it, unless in the meanwhile we have as a prudent people taken steps to increase our domestic production, our surest dependence in every contingency.

It is clear that from the situation as presented in the foregoing figures and conclusions, the United States can never expect to become a sugar-exporting country, and more important it is, therefore, as dictated by every consideration of self-interest that we direct our attention at this time to increasing the domestic production, from cane and beet, by every reasonable and proper means at our command. The section to which fostering care gave wealth, our own people in it would be given additional field for employment, our national wealth be increased and nothing to go out of the country to enrich foreign states to the extent we should carry domestic production.

It has been said that the North and West are capable of supplying our entire consumptive demand with beet sugar. Sure there is a belt in the South extending from the Atlantic to the Rio Grande, embracing Louisiana, possessed of a climate and a soil that can be made to supply, under scientific direction, a very large part of our demand. These are the particular questions for us to discuss in any consideration of the sugar supply of the United States.

In building up a domestic production of sugar, we are building for time and emancipating ourselves from foreign dependence.

To-day's sugar is the only product of our soil that enters so largely into our daily life, that makes us debtor to foreign lands for much of our supply.

No other food product has grown in public favor with such remarkable strides as we have seen in the case of sugar, or better sustained the most nutritious powers claimed to result from its judicious use. Few people are aware of the numerous uses that go to make up the extensive consumption of sugar, and in this respect how it compares with other food products and how its growth has run on parallel lines with them.

The per capita of wheat consumption in the United States in 1873 was 4.81 bushels; corn (for man and beast) 22.86 bushels; cotton 15.19 pounds; coffee 5.01 pounds; tea 1.09 pounds, and sugar 39.8 pounds.

At close of year June 30, 1902, per capita consumption of wheat is placed at 6.50 bushels (including flour); corn (for man and beast) 18.92 bushels (including meal); cotton, 25.65 pounds; coffee, 13.37 pounds, and sugar 72.8 pounds.

In twenty-nine years, while the consumption of wheat has increased 35 per cent per capita, corn has declined 17 per cent; coffee has increased 167 per cent, and sugar has increased 83 per cent.

In money values in 1902, we were consuming per capita of wheat, $5.50; of corn (for man and beast), $8.50; of cotton, $2.13; of coffee, $0.68, and of sugar, $3.61. We pay foreign countries annually about $100,000,000 for sugar, besides the tolls to foreign bottoms for its transportation, and when it reaches the consumer an amount has been expended for it that requires for its liquidation nearly our combined wheat and flour exports, or nearly double our exports of corn, or three times our exports of cattle, horses, mules, sheep, and poultry, or double our exports of oil.

The duty upon imported sugar supplies more than one-fourth of the receipts from customs and stands for one-twelfth of the income of the United States from all sources. Besides this, the duty enables the North and West to produce beet sugar, and the South to produce cane sugar; in competition with tropical labor gives employment for our people in both sections and increases the country's wealth in the large investments necessary in plants to conduct the manufacture and for agricultural implements required in both cane and beet cultivation.

The universal use of sugar by the people of this country makes it an ideal subject upon which to base revenue because the burden is so evenly distributed. None of us are ready for direct calls upon the States for the support of the general government as long as it can be raised by equitable revenues, though they incidentally give protection.

Your speaker takes it for granted that his audience needs no information in regard to beet cultivation. He may be able to throw some light upon the prospects of cane cultivation in Georgia and Florida and the South.

Georgia was considerable of a sugar State eighty years ago, but cane cultivation was crowded out by cotton and rice because yielding better profits than cane. We are now engaged in an effort to restore cane cultivation in Georgia to its former importance, that in time we may again become in part a sugar State, and are meeting with every encouragement, though our efforts for the present are in the direction of converting our cane juices into the well-known syrup of Georgia.

Florida engaged in cane planting and manufactured sugar as early as the year 1767, and has always made more or less common brown sugar for home use.

The richness in sugar content of the cane of Georgia and Florida exceeds that of Louisiana and compares favorably with the Cuban cane, yielding as high as 35 tons of cane to the acre on best suited lands with thorough cultivation.

Quite recently the United States Department of Agriculture analyzed some sugar cane from South Florida, a sample of the ordinary cane of that section cultivated in the ordinary way, that gave a sugar content as high as 19.8 per cent.

Dr. H. W. Wiley, Chief of Bureau of Chemistry, Department of Agriculture, under whose direction these South Florida canes were analyzed, said in a letter to the gentleman upon whose farm they were grown:

"These are the most remarkable samples we have ever examined. They contain no glucose or reducing sugar whatever when tested by the ordinary method."

The astonishment expressed by Dr. Wiley at the results of the analysis of the South Florida cane is not a matter to be wondered at when it is remembered that they exceed in sugar content the cane of Hawaii and Cuba. This may be the starting point for science in doing for the sugar cane what it has already done for the pudgy beet, and that in the next ten years, cane cultivation under its direction may be productive of as marvelous results. Certain it is, that all interested in cane cultivation recognize the imperious necessity of more scientific study for increasing the content of sugar and per acre tonnage.

At the Interstate Sugar Cane Growers' Convention that convened in Macon, Ga., on May 6 and 7, ultimo, and at which Secretary of Agriculture Wilson was present, and delivered a masterly and eloquent address on "Southern Agricultural Possibilities," a paper was read by Mr. W. D. Roddenberry, a successful farmer of Thomas County, Georgia, in which he gave the details of running his 380-acre farm, particularly with reference to showing the profitableness of cane growing for syrup making. From cotton, potatoes, watermelons, and other crops, he realized about $6.00 per acre net profit; and 46 acres of farm in sugar cane, the juice of which he manufactured into syrup, yielding a net profit of $84.47 per acre.

Land such as Mr. Roddenberry cultivated can be bought, in cultivation, anywhere in Southern Georgia or Florida at $10.00 to $20.00 per acre, according to the improvements upon the land.

Mr. Roddenberry's is not an exceptional case, and because syrup-making is so profitable, our cane growers are not making sugar, but such practical illustrations demonstrate the superiority and richness of our cane for sugar making.

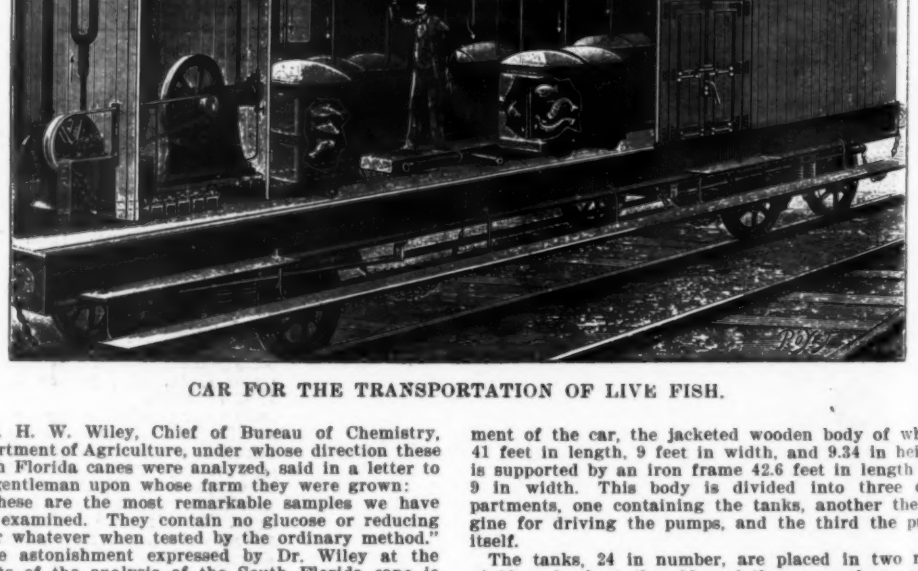
Sugar cane in the South is a white man's crop, because it is laid aside in July, and the cultivator escapes the hot southern sun in July, August, and September, where in cotton and other staple crops the cultivator must be exposed to the end of the harvest. Sooner or later these facts will impress themselves upon the public mind and a tide of emigration will set south to grow sugar cane and manufacture sugar, for there is not a finer field for this kind of work than the South affords to-day.

There is no branch of agricultural industry more promising in results. We have the lands and want your energy. We extend to you, one and all, a most hearty welcome. Join us in the building of a sugar industry in the South that we may join you of the North and the West in freeing our common country from dependence upon foreign nations for one pound of our sugar supply in the future.

THE TRANSPORTATION OF LIVE FISH.

THE business of transporting living sea fish has in recent years been extensively developed. When it is a question of supplying large cities situated not far from the coast, the problem becomes simplified; but, when, on the contrary, it concerns the carrying of live fish to great distances, the question presents certain difficulties that result from the necessity of renewing, *en route*, the water of the tanks in which the fish are transported. Such is the case with the supplying of the German and Russian markets with fish caught off the French coast of the Atlantic or off the Italian coast of the Mediterranean. Numerous experiments have been making for a long time past with a view to improving such transport by railway, but in most cases without success. Herr Krautz, a merchant of Berlin, who is specially occupied with the transportation of fish for the German and Russian markets, has been making some researches of his own and has recently succeeded in devising an arrangement that gives entire satisfaction. The principle of this arrangement consists in placing the water tanks containing the fish along the sides of the car and connecting them together by means of rubber pipes. These latter are in turn connected with a suction pipe ending at a pump which, by means of a force pipe, sends the water into the various tanks through nozzles. In this way there is obtained a continuous renewal of the water of the tanks, with an aeration of the latter through its contact with the external air.

The accompanying figure shows the internal arrangement of the car, the jacketed wooden body of which, 41 feet in length, 9 feet in width, and 9.34 in height, is supported by an iron frame 42.6 feet in length and 9 in width. This body is divided into three compartments, one containing the tanks, another the engine for driving the pumps, and the third the pump itself.



CAR FOR THE TRANSPORTATION OF LIVE FISH.

The tanks, 24 in number, are placed in two rows of 12 each along the sides of the car, and separated by a longitudinal passageway. Each of the tanks is connected, by means of a small pipe, with a conduit placed on a level with the floor and divided into two parts connected in front and ending, through one pipe in common, at the pump. This latter forces the water into a pipe placed at the upper part of the car above the tanks. Upon this pipe, opposite each tank, are three branches consisting of vertical tubes provided at the lower part with nozzles through which the water is introduced into the tanks at an inch or so above the level of the liquid. Each of the tanks, of a capacity of 132 gallons, is capable of holding 330 pounds of fish, which makes a total capacity for the 24 tanks of 7,920 pounds. The tanks are closed at the upper part by a rounded cover of galvanized iron, containing an aperture for the passage of the nozzle.

The engine that actuates the pump is a 2-horsepower benzine motor running at a velocity of 200 revolutions a minute. The water for cooling the motor during its operation is furnished by a steel plate reservoir.

As for the sparking of the motor, that is effected through an electric battery of six bichromate elements. In case of the non-operation of the battery, a special igniter supplies the place of it. The force and suction pump is of the Broquet type. Actuated by a belt, it is capable, at a velocity of 125 revolutions a minute, of forcing 90 cubic inches of water a minute and of renewing the water of the tanks about ten times an hour. The car, which is supported by two trucks spaced 23 feet apart from center to center, weighs, when empty, 60,390 pounds, and is capable of carrying a mean load of 34,540 pounds.—Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

MONGOLIA AND THE MONGOLIANS.

THE territory of Mongolia embraces about 50,000 square miles. The inhabitants that people this immense tract of land number at least three million souls. (1) The most important are the Khalkas, or Mongolians, properly so called, who occupy the entire north of Mongolia; (2) then come the Ouryantai and the Darkhat, who are merely Mongolized Turks; (3) the Ordos of pure Mongolian blood; (4) finally, the eight tribes of the Tsaktar, of Mongolian blood.

The name of the Mongolians became suddenly known in the thirteenth century, and the world was soon filled with the narratives of the exploits of these nomad warriors. The celebrated chief known to history as Djenguis-Khan (or Genghis-Khan) was born probably in 1162. By his ardor, courage, and successes, he grouped around him a band of young warriors, took part in a number of wars between the Chinese and Mongolians, fighting now on one side and now on the other, subjugated all the tribes living between Irtych and the Khingan Mountains, and in 1206, at the diet of the Mongolian nobles that he had assembled, received the title of Djenguis-Khan, or "the most powerful prince," under which he was to be known to posterity. Marching from conquest to conquest, he soon became master of the southern provinces of China, and in 1210 made himself master of Bokhara and Samarkand. Seven years later, he died, while his army divided into three parts, one of which marched against Afghanistan, another against Russia, and the third completed the conquest of China.

In 1237 the whole of Russia, except Novogorod, was paying tribute to the Mongolians, who next invaded Poland and Silesia, and finally Moravia and Hungary. At this period the power of the Mongolians was at its apogee; but, at the end of the thirteenth century, it declined, and in 1368 these people were driven from China, and the prince who had occupied the Chinese throne returned to the steppes of the north, with his vassals, where he reigned over his fellow countrymen only. A century later, the Mongolians were beaten and dispersed by the Russians, who had been their vassals for two centuries.

Subsequently, the Khans of southern Mongolia acknowledged themselves vassals of the emperor, Son of Heaven, the "Bogdo-Khan." Northern Mongolia, that is to say, the country of the Khalkas, divided into four principalities, remained independent for a longer time, but in 1691 placed itself under the protection of the Emperor of China.

In our day, the Khalkas are still divided into four "aimaks," or principalities, the creation of which, it is said, dates back to Djenguis-Khan. There are Toucheton, Tsetsen, Saïn-Noïn, and Tsatsatkou. Each aimak is divided into "khochouns," which are subdivided into "soumyns." Such distribution of the territory is very ancient.

Although the Mongolians are vassals of China they govern themselves. In each administrative subdivision there is elected a chief, whose election is ratified by the Chinese government, and who receives from Pekin a title of honor of slight importance, along with a button or peacock's feather for his cap. At Osuga, the Mongolian prince in charge (theoretically) of the administration of the affairs of the Khalkas has for adjunct (theoretical) a Mantchoo envoy, the "ambane," who is really the master of the situation; and the decisions made in common (or that are supposed to be) by the two exalted persons are those dictated by the ambane, that is to say, the Pekin government.

The Khalkas are nomads, but only relatively so. Within the limits of their khochoun and soumyn they periodically shift their quarters in search of "pastures new" for their herds, but they never travel very far, and it is always possible to find an encampment within a radius of a few miles.

They live under the "yourte," which consists of a light circular framework covered with pieces of felt. The form is that of a dome supported by a small substasement, and about ten feet in height. In order to render it habitable, it suffices to cover it with pieces of felt and close the central orifice above with a movable piece of the same material. It is through this orifice that escapes the smoke of the "*pot à feu*." The fireplace is situated in the center of the abode, the household gods are placed opposite the door, and the housekeeping utensils are arranged along the walls. All around the fireplace are spread out, in lieu of seats, pieces of felt, for which the well-to-do substitute carpets. The princely yourtes are furnished with board floors and decorated with silken hangings.

In summer the men wear wide trousers and a shirt of calico, in most cases blue—let us say, a complete "pajama." Over this they place a long robe, which is buttoned upon the shoulder and side. This is of blue or brown cotton, but sometimes of red or dark green silk. The lamas, or church people, affect yellow. This robe is gathered in at the waist by a cloth girdle whence, to the right, hangs a knife (of Chinese style among the wealthier, that is to say, a knife and ivory chop sticks in the same sheath; and, among the poor, a simple vegetable knife in a wooden sheath), and to the left a tobacco bag and tinder box.

Boots with pointed upturned toe and high heel, generally of red leather with a thick sole, complete the accouterment. The fact that the Mongolian shoemakers make but one size of footgear explains at once why the son, at a pinch, puts on the boots of his father, and why the Mongolian (who, however, is naturally lazy) does not like to take even the shortest walks afoot. He bestrides his horse in order to travel a distance of a hundred paces, and it is only during the coldest weather that he decides to dismount from his steed in order to walk half a mile or more.

The Mongolians shave and wear a cue. As for headgear, they have a national hat which is rather astonishing. It consists of a small cone of figured silk or damask, which forms the skull-cap. The rim, which is of black velvet, is turned up so as to describe an acute angle with the central cone. Behind, float two long wide ribbons, which are invariably of red silk. The button or the tuft that crowns the cone is likewise always red. When it rains (a rare event in the Khalka country) the velvet rim is turned down, and the hat assumes the form of an extinguisher that protects the ears and neck. In winter, these hats are replaced by a headgear trimmed with fur (that of the squirrel among the poor, and that of the sable among the rich), and the change of hat is accompanied with a change of costume. The long cotton or silk tunic is replaced by a mantle of sheep or deer skin, or among the rich, by a long coat of silk trimmed and lined with costly fur.

The majority of the Mongolians are thin and emaciated. Although they are not strong, they are wiry and capable of withstanding considerable fatigue on horseback. But they must not be asked to do any muscular work whatever. It takes two or three to lift a weight that could be easily handled by one Cossack. To the European eye, they are, with their broad, flat noses, their high cheek-bones, and their little, beady eyes, intensely ugly. They are generally of a low stature, and sometimes have a certain nobility of countenance. Almost all have a kind, benevolent expression to which one soon becomes habituated.

In their youth, the women are very prepossessing. Their lineaments are refined, their eyes very languishing, and their faces plump and smiling like those of the Japanese. They wear the same underclothing that the men do; the same boots and the same hat. But the married women wear a long tunic with very narrow sleeves that are generally red from the middle of the arm to the wrist, which is covered by a small point of the sleeve, if the latter is not rolled up. The robe may be blue, brown, violet, or red, but the sleeve is always red. Above the shoulder the sleeve is padded to a considerable height; so the Parisian ladies of 1895 had invented nothing in the way of sleeves. A tucker of this same red color covers the top of the throat.

Maidens, whose robes resemble those of men, wear

MONGOLIAN WOMEN.

their hair in a single braid hanging down the back. Their jewelry consists simply of hammered or filigree silver earrings; but the married woman has a right to two braids, which she wears hanging in front, and to a head-ornament of silver, which is bejeweled with uncut stones, rubies and sapphires, but oftener with turquoises and coral, and which, in families, passes from mother-in-law to daughter-in-law, and is the first present from a man to her whom he has selected to be his companion for life. This ornament consists of a semicircular band placed flat upon the forehead, and of two fan-shaped pieces placed at the level of the ears, and in which spread out the flattened and thickly pomaded braids, and, finally, of a series of round plates that are attached to the extremity of the braids. Sometimes a series of small bars holds the widened part of the braid between the ear plates and the frontal diadem. More rarely—and this is the case with high-toned, elegant ladies only—the braids are inclosed in their entirety in long sheaths of chased silver.

As for the children, they go about bravely *in puris naturalibus*, at least during the summer season, and it is not till they have reached the age of ten that they are clad in the long national tunic.—For the above particulars and the engraving, we are indebted to Le Tour du Monde.

German Capital in the Transvaal.—The capital invested by Germany in the Transvaal is estimated by experts to be fully $150,000,000. It is invested in commercial houses, real estate, loans, mines, etc.

PRODUCING HELIUM FROM RADIUM.

NUMEROUS researches on the self-ionization of the gases of the atmosphere as well as on the excited radio-activity produced by this phenomenon, have been carried out of late years. It is of interest to state the rôle played by the inert monoatomical gases of the atmosphere in connection with the phenomena in issue. W. Ramsay and F. Soddy (Physikalische Zeitschrift) used to this effect a small electroscope contained within a glass tube, the internal wall of which was lined with a layer of tin foil. The apparatus once charged retained its charge without any appreciable losses during 36 hours, provided a vacuum was produced, whereas on introducing air a slow diminution occurred. With analogous experiments on the above-mentioned atmospheric gases, the amount of discharge was proportional to the density and pressure of the gas. From this fact the conclusion may be drawn that the gases do not possess any specific radio-activity of their own, the electric conductivity of the air being due to a radio-activity from a foreign source.

The same authors further made some experiments on the nature of the radio-active emanation of radium. In connection with researches on the chemical nature of the emanation from thorium and of that given off by radium, Rutherford and Soddy arrived at the conclusion that these emanations are constituted by inert gases, resisting the influence of reactives to a degree similar to that observed only with the gases of the argon group. The authors on the other hand state that the emanation from radium mixed with oxygen resist the prolonged action of an electric spark when placed above an alkali, the discharging power remaining intact during this treatment and the luminosity the gas possesses affording optical proof of its persistence. This emanation may be treated like a gas; it is condensed in a U-shaped tube surrounded by liquid air, and in this state washed by means of another gas which it is possible wholly to eliminate by means of a pump. In a dark room the eye easily observes the gradual advance of the emanation as it passes from one point of the tube to another. When opening the cock between a tube containing this emanation and the pump a gradual stream is observed through a capillary tube, as well as the rapid passage through wider tubes, the delay produced by a stopper of phosphorus pentoxide, and finally, the sudden diffusion into the reservoir of a pump. The phenomena shown by the excited activity that remains on the glass after the passage of the emanation could equally be readily observed. The emanation, in a way similar to that noted with radium salts, gives rise to the most different chemical effects. As the emanation from 50 mm. of radium bromide is dissolved in water and kept together with oxygen within a small glass tube above mercury, it imparts to the glass a most noticeable violet tint, whereas in the presence of moisture, the mercury becomes covered with red oxide.

The authors next examined the gas developed by 20 mm. of radium bromide dissolved in water, this gas being mainly made up of oxygen and hydrogen, with a view to stating the presence of helium by means of spectral measurements. They succeeded in stating the coincidence of a line in the spark specter of this gas with the D_3 line of helium, this coincidence being established by the simultaneous projection of both specters.

The emanation given off by 50 mm. of radium bro-

mide has been led by means of an oxygen current into a U-shaped tube, cooled by means of liquid air and exhausted. After washing it with some fresh oxygen, the pump was worked for some time. The vacuum tube sealed to the U-shaped tube has not shown evidence of the presence of any helium after elimination of the liquid air. The spectrum was evidently new, most likely that of the emanation. As, however, the researches so far made are far from being complete, the authors hope to publish later full particulars of this spectrum. After some days had elapsed, the spectrum of helium was noted, the characteristic lines being identical with those of a helium tube projected at the same time into the visual field.—A. G.

TRADE NOTES AND RECIPES.

Liquid Brilliantine.—

Olive oil	4 fluid ounces
Glycerine	3 fluid ounces
Alcohol	3 fluid ounces

—Oils, Colours, and Drysalteries.

Making Waterproof Canvas.—For this purpose a solution containing equal parts by weight of gelatin and chrome alum is usually employed. It is not advisable to mix more of the solution at once than is sufficient to give the canvas one coat, as, if the mixture once sets, it cannot be reliquefied like a plain solution of gelatin, and hence if the quantity of canvas to be waterproofed is small, it would, perhaps, be preferable to coat with plain gelatin solution until quite impervious to cold water, and then to thoroughly soak for, say, twenty-four hours in a strong solution of chrome alum.—Bull. of Pharm,

To Protect Black Sheet Iron from Rust.—Before black plate is ready to receive a rust protective coating, it is necessary to render the surface free from grease and scales, for which purpose the sheet iron is placed for some time into a warmed solution of 10 parts of sulphuric acid in 100 parts of water, whereby the impurities become detached, a process which may be assisted and accelerated by scouring with sand. Then rinse in clean water and rub dry in sawdust. The sheets thus prepared are placed for a short while into a feeble solution of blue vitriol, where they assume a reddish coloring. Next they are rinsed in water and after that moved to and fro, for a short time, in a feeble solution of hyposulphite of soda acidulated with a little hydrochloric acid. The result is a dark blue coating on the sheets, which prevents all oxidation.—Der Metallarbeiter, Vienna.

The following from the Druggists Circular and Chemical Gazette will probably be of interest. The so-called "banana solution" (the name being derived from its odor) which is used in applying bronzes of various kinds is usually a mixture of equal parts of amyl acetate, acetone, and benzin with just enough pyroxylin dissolved therein to give it sufficient body. Powdered bronze is put into a bottle containing this mixture and the paint so formed applied with a brush to the article to be bronzed. The thin covering of pyroxylin that is left after the evaporation of the liquid protects the bronze from the air and keeps it from being wiped off by the cleanly house-maid. Tarnished picture frames and tarnished chandeliers to which a gold bronze has been applied from such a solution will look fresh and new for a long time. Copper bronze as well as gold bronze and the various colored bronze powders can be used in the "banana solution" for making very pretty advertising signs for use in the drug store. Lettering and bordering work upon the signs can be done with it. Several stiff, very small painter's brushes are needed for such work and they must be either kept in the solution when not in use, or, better still, washed in benzin or acetone immediately after use and put away for future service. It is needless to add that as the "banana solution" is volatile it must be kept well corked.

Green Ink.—A good, bright green aniiin ink may be made as follows:

Aniiin green (soluble)	2 parts
Glycerin	16 parts
Alcohol	112 parts
Mucilage of gum arabic	4 parts

Dissolve the aniiin in the alcohol, and add the other ingredients. Most of the gum arabic precipitates, but according to the author of the formula (Nelson) it has the effect of rendering the ink slow-flowing enough to write with. Filter.—Nat. Drug.

Klaproth's Green Ink.—This has the following formula:

Copper acetate, crystallized	4 parts
Cream tartar	2 parts
Water	16 parts

Boil the copper and cream tartar with the water in a porcelain kettle (a clean copper one will answer) until the solution acquires an intensely green color, then filter and add 1 part of mucilage of gum arabic.

Chrome Green Ink.

Potassium dichromate	10 parts
Hydrochloric acid	10 parts
Alcohol	10 parts
Gum arabic	10 parts
Water	30 parts

Powder the potassium dichromate finely, put in a capacious earthen or porcelain vessel, and pour over it the acid. Let stand for an hour or so, then cautiously add the alcohol a little at a time, stirring continuously with a glass rod. The effervescence arising after adding each portion of alcohol must be allowed to subside before adding another. Now neutralize the green liquid thus produced by adding sodium carbonate in finest powder, a little at a time, and watching the liquid carefully, and ceasing the addition as soon as a green precipitate begins to form. Cover the vessel closely, and set aside for a week or ten days, then filter, and dilute the filtrate with water until it reaches the desired shade of green. The addition and solution of the gum arabic completes the operation.

Chrome green ink is one of the most stable and lasting inks that we know of, and may be used with entire confidence for almost all kinds of documents. It penetrates the paper deeply, and does not fade, even if exposed for a long time to the direct sunlight.—Nat. Drug.

ELECTRICAL NOTES.

When a solution of aconitic acid, to which half the quantity of sodium hydroxide necessary for complete neutralization has been added, is electrolytically reduced, using a cathode of mercury and an anode of platinum, and an apparatus designed to prevent as far as possible oxidation at the anode, a yield of 60 per cent of the theoretical quantity of tricarballylic acid is to be obtained. Such is the conclusion drawn by Mr. Ch. Maril from a series of experiments on the subject. The acids were separated by conversion into their copper salts, that of aconitic acid being soluble in dilute acetic acid. Cinnamic acid can by this method be converted quantitatively into phenyl-propionic acid.

What is claimed to be the first American central station equipped throughout with Diesel oil engines has been running—according to the American Electrician—since the middle of last July in Jewett City, Conn., a town of 3,000 inhabitants. Steam power plant could not be considered by the small community, on account of its high first cost, and the authorities decided upon an oil engine installation, after receiving a guarantee from the contractors to the effect that the crude oil consumption per brake horse power hour of the engines was not to exceed 0.47 pound at full load. The cost of attendance being a comparatively small item, a kilowatt-hour, including wages and supplies, with crude oil at 4.6 cents per gallon delivered, was calculated to come to about 1 cent. The station, 37 feet 8 inches by 30 feet 8 inches over all, contains two 60-kilowatt single-phase 2,200-volt 60~ alternators, belt-driven by two 75 B. H. P. triple-cylinder Diesel oil engines, the cylinder bore of which is 10 inches, the common stroke being 15 inches, with cranks displaced by 120 deg. one from the other. A brick chimney, 8 feet high, serves for conducting into the atmosphere the exhaust gases. Underneath the engine room are located two oil storage tanks, the combined capacity of which is 6,500 gallons. The wiring and switchboard arrangement of the station is carried out on usual lines.

In his annual report John B. Hobson, general manager of the Consolidated Caribou Hydraulic Mining Company, Bullion, B. C., presents figures of cost of operating electric drills. The plant included four drills with 2-horsepower, 110-volt, direct-current portable motors; one drill wih 1½-horsepower, 110-volt, direct portable motor, all complete, with 7-foot flexible shafts, adjustable tripods, drifting columns, the necessary flexible cables, working tools, and five sets of drills of suitable lengths to drill holes varying from 2 to 8 feet deep. The figures are: Steam power: One cord of cedar wood, delivered, $2.25; one engineer, $4; lubricants for engine and generator, 35 cents; total, $6.60. Operating drills: Three power drill men at $4 each, $12; three helpers at $2 each, $6; one blacksmith, $4; one helper, $2; three bushels of charcoal at 25 cents, 75 cents; lubricants, 20 cents; total, $24.95. Total cost of running three drills ten hours, $31.55. The duty attained by drills used during the season, in advancing and lowering the bed rock cut, averaged 312 feet of holes per ten-hour shift. The duty attained by two miners drilling by hand, with ⅞-inch steel and 8-pound hammers, averaged about 14 8-10 feet per ten-hour shift, and made the cost of drilling 312 feet of holes in bed rock by hand as follows: Forty-two miners at $2 per day, $84; one blacksmith at $4 per day, $4; one helper at $2 per day, $2; four bushels of charcoal at 25 cents, $1; total cost of drilling 312 feet of holes by hand, $91. Saving made in favor of power drills per ten-hour shift, $59.45.

An experimental investigation carried out with a Jungner alkali accumulator and an ordinary storage battery for the purpose of comparing the two as to their behavior during charge and discharge, their capacity, temperature, and concentration changes of the electrolytes and the relation between capacity and current strength is described by Schoop in the Elek. Zeit. The author thinks that it is more correct to call the former a Jungner-Edison accumulator than the reverse, in so far as the English and German patent offices have considerably modified Edison's patent claims on account of Jungner's objection, and the latter apparently found out before Edison did that nickel oxide is a depolarizer which can be used on a practical scale if it is suitably fastened to a support. The Jungner accumulator was composed of 5 negative and 4 positive plates, the plates being formed of pockets of perforated nickel-plated sheet steel, which contained the active material. The latter is composed of nickel oxide for one plate and cadmium or iron in finely divided state for the other; they are introduced in a pasty form into the pockets. The lead accumulator was constructed with the same number of plates and weighed about the same; it was always connected in series with the alkali cells. The author comes to the following conclusions respecting the Jungner accumulator: The alkaline electrolyte does not change its physical or chemical nature during charge and discharge and merely transports the oxygen from one electrode to the other; small amounts of liquid are, therefore, sufficient. The electrolyte diffuses during discharge from the pores of the nickel electrode into those of the cadmium electrode, while the density between the plates is changed. This diffusion is quite rapid owing to the small distances between the plates. The best conducting alkali does not conduct as well as the best conducting sulphuric acid and tends to absorb carbonic acid from the air. The proper working of the electrodes is independent of the concentration of the electrolyte within comparatively wide limits. The active materials have to be carried in pockets and have a bad conductivity; the internal resistance is, therefore, two or three times as large as in the lead accumulator. The capacity is influenced by the strength of the discharge current to considerably lesser degree than in the lead accumulator; the influence of the temperature of the electrolyte on the capacity is inconsiderable. The loss of potential amounts to 35 to 40 per cent, and still more with slow discharges. The efficiency in ampere hours is about 80 and in watt-hours about 65 per cent.

ENGINEERING NOTES.

Municipal automobiles seem destined to find favor in Great Britain, where a few of them are already in regular service for collecting rubbish or carting away the clinker produced in the destructor plants. In Chelsea, Mr. T. W. E. Higgens uses three of these vehicles in his work as borough surveyor. One of them has a detachable dumping body which can be replaced by a tank, and while thus arranged it is used to haul a street-sweeping machine. In this way the automobile both sprinkles and sweeps the street. Most of them are steam vehicles, of which several types are in use. Mr. Higgens is convinced that in a large district or where the dumping boards are some distance from the place where the refuse is collected, motor carts may be used with economy. But when employed for general cartage or sprinkling, where it is possible to get 18 hours' work out of each cart daily, they will be found a distinctly valuable addition to the usual plant.

The recent calamity on the Paris underground railway has seriously affected the quotation for Central London Railway stock, which during the past week has lost several points. Holders are evidently afraid that the British public will abstain from patronizing the "twopenny tube" as much as of yore, but it should be remembered that the public are only nervous for a short time. The statements made by the general manager will go far to reassure the public. The cost of the accident to the Paris company will, it is generally believed, amount to £200,000, which is a very considerable item. To demonstrate how railways are affected by an accident, it may be stated that the Metropolitan, which experienced only a minor accident during the last half-year at King's Cross, could have paid an extra one-half per cent had it not been for the misfortune in question. The City and South London tube announces a traffic decrease of £890, while the total decrease for the past five weeks is £2,290.

The rate of total progress of the Simplon Tunnel during the month of May was 9.60 meters per day; 4.10 meters through the schistic gneiss and calcareous mica on the Swiss side, and 5.50 meters through the mica schist and gneiss on the Italian side. The daily rate of over 11 meters in June, during which month there was a total advance of 334 meters, was therefore a slight augmentation, and, in presuming that rate of progress were continued until the finish, the two headings would meet about the end of April, 1905. The water infiltration at the Swiss side is only about 40 liters per second as a total. The rock temperature remains almost stationary. The new international line of the Mediterranean railway between Arona and Domodossola is also making notable progress, the Masone Tunnel now having been bored right through, while a number of smaller ones are well advanced. An embankment several kilometers long and about 30 feet high crosses the Ossolian Valley diagonally from Beura to Crevola. There are some 3,000 men at work all along this new line.

The profuse use of water spraying in mines has unfortunately assisted in the introduction of a most serious disease into collieries, viz., "ankylostomiasis," which is at present mostly confined to Austrian, German, and Hungarian mines, but has been discovered in some mines in Cornwall, and also in Australia where those suffering from the disease are called "earth eaters." This disease appears to have been first noticed in Hungary, thence spread to Austria and thence to Germany. It is in the latter country that the disease has received the greatest attention, and ample proof has been given that since the introduction of watering into pits to moisten the dust, the virulence of the disease has greatly increased. The higher the temperature, and the greater the point of saturation, the more easily is the parasite propagated, and therefore its favorite habitat is in the damp and badly ventilated places. The larvæ can exist in any temperature above 48 deg. F., and have been found on the higher parts of props and bars but not near the floor. Fortunately, the first accounts are believed to have exaggerated the danger, and were incorrect in stating that the infection could be carried through the air; but later investigations seem to point out that it can only be taken in through the mouth, and therefore clean hands and clean water, when partaking of foods, are the principal safeguards.—Mines and Minerals.

Of the numerous alloys now in use for improving carbon steel, the following deserve special mention, as all of them are produced in quantity, and, therefore, represent commercial products, which may be bought in the present market: 1, ferronickel; 2, ferrochrome; 3, ferrocobalt; 4, ferrochrome nickel; 5, ferrotungsten nickel; 6, ferrosodium; 7, ferroaluminium; 8, ferrotungsten; 9, ferrosilicon; 10, ferrophosphorus; 11, ferromolybdenum; 12, ferrotitanium; 13, ferromanganese; 14, ferrovanadium; 15, ferroboron; 16, ferrouranium; 17, molybdenum nickel; 18, copper silicon. These alloys have become prominent in later years, and are employed in the production of steel, containing a definite percentage of the respective alloying metals. They are added to the molten steel either in lump or powder form, but preferably inclosed in cast-iron tubes, and are thus inserted into the steel bath with perfect assurance of incorporating the whole amount of the charges made. Each of the compound steels thus obtained possesses peculiar and characteristic properties which make it fit for a special purpose, and almost all are known to improve the toughness and elongation of carbon steel, while some of them impart a great hardness and elasticity to that substance. As to the nature of alloys in general, it must be remembered that they are comparable in a degree to "solutions," and are distinguished in chemistry as "undetermined compounds." In many respects they show the average deportment of the metals from which they arise, but, by combining the various metals, alloys of the desired properties can be produced, and on this behavior is based their technical application. To cite a familiar example, gold and silver, which are very soft when in pure condition may be essentially hardened by alloying them with copper; and copper itself is rendered harder by alloying it with zinc.—Dr. J. Ohly in Mines and Minerals.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Methods Needed to Secure Foreign Trade.—The British consul at Asuncion, in the British Board of Trade Journal, says:

"With the object of obtaining information as to the classes of goods sold and the manner of doing business with houses in the United Kingdom, I have lately visited and conversed with some of the principal firms here. . . . My informants declare that the non-adoption in the United Kingdom of the metric system of weights and measures is a serious drawback to our trade. What is wanted, they declare, to increase the sale of British goods is an agent in Asuncion receiving samples of all kinds from firms in the United Kingdom. . . . In previous reports allusion has been made to the offer of the Chamber of Commerce of Asuncion to devote a portion of the space of their showrooms to samples of British goods. It is to be regretted that no response has been made to this offer."

Below are the official figures reported by the consul of the values of the imports into Paraguay during the year from the United Kingdom, France, and Germany:

United Kingdom	$837,646
France	401,326
Germany	316,405

The chief business houses in Asuncion are of Spanish, German, French, and Italian nationality.

Further on in his report the consul writes:

"In view of the development of the chilled and frozen meat trade between the Argentine Republic and the United Kingdom, it is perhaps of interest to consider whether a branch of this industry could not be made profitable in Paraguay. In this country (Paraguay) the price of good slaughter animals is one-half that of such animals in the Argentine Republic, being in the Argentine from £5 to £5 10s. ($24.33 to $26.76) per animal and here £2 10s. to £3 ($12.16 to $14.60). . . . Paraguayan meat, if in good condition and properly handled before slaughter, is of fair quality, the animals being, of course, fed entirely on natural grasses."

India's Imports.—According to the Deutsche Industrie Zeitung, the German consul-general reports from Calcutta that Germany's exports to India during 1901-2 show a considerable increase over 1900-1901. After Great Britain, with fully two-thirds of the total, Germany's rivals for India's trade are Austria-Hungary, France, Belgium, Russia, and the United States. Germany's share of the steel trade is emphasized. In this, Great Britain and Belgium are the only countries that supply more. It is remarkable that Belgium leads in this line, considerably ahead of Great Britain and seven times as large as Germany's shipments. In knives and hardware Germany follows closely after Great Britain. It has an important place in the lists of drugs, chemicals, medicines, dyes, and tanning materials. In machinery, Great Britain and the United States are far ahead. Among the cotton goods that go to India, hosiery and underwear occupy a very important place. The imports of these goods have gone up threefold in five years. In the importations of carpets, Germany comes after Great Britain. The same is true of woolen underwear. In furniture—fine furniture—rubber goods, and toys, Germany is second, Great Britain leading. Great Britain and Belgium lead in weapons, munitions of war, explosives, stoneware, china, etc., Germany coming third. Of the importations of paper, papier-maché, and writing materials, Great Britain and Austria-Hungary lead, with Germany third. In glass and glassware, Austria and Belgium have beaten the Germans. The United States leads her in instruments, scientific tools, books, printed materials, wagons, cars, etc.

As supplementary to the foregoing, the following figures, prepared by the Bureau of Statistics, show the commerce of the United States with British India for the years 1901-1903:

Year.	Imports from India.	Exports to India.
1901	$43,882,493	$6,251,804
1902	48,421,218	4,621,876
1903	49,774,589	4,795,411

German Demand for Modification of Meat Inspection.—The society for protecting the general interests of German commerce and industry have petitioned the Bundesrath to modify the laws of June 3, 1900, and July 12, 1902, regarding the prohibition of importing canned meats or sausages, the inspection and examination of cured meats and lard, and the excessive fees collected for such services. In joining this movement the Stettin Chamber of Commerce has the following to say:

"With right does the society claim that through these regulations the trade is burdened considerably more than what is necessary for veterinary and sanitary purposes. With right do they claim that the prescribed fees do not bear a comparison with the services rendered, and that a necessary food is unnecessarily increased in price, and in some cases the importation made impossible. Considering the loss to the working class of people as well as to commerce, we give this petition our indorsement."

In this connection it might be of interest to note that the chief customs inspector for the Province of Pomerania has issued an order that canned meats and pieces of cured or salted meats weighing less than 8 pounds (the importation of which the law of June 3, 1900, prohibits) can, provided they do not go inland, enter the free harbor and remain there until exported. The object of this order is to enable the foreign-bound ships to provision with the indispensable article of canned beef. It is a well-known fact that every navy and deep-sea merchantman is provisioned with American corned beef, and it thus seems that it is not considered injurious to the German sailor, whether in the navy or merchant marine, while, on the contrary, it is considered dangerous to the German landsman.—John E. Kehl, Consul at Stettin.

German and American vs. French Coal in France.—In reply to an inquiry as to the interest now being taken in this region in American coal, I am obliged to report that no American coal has yet been marketed here in quantity. Should our coal ever reach the interior cities of Europe it will be only after the trade has been firmly established at the coast ports, and then only to reach such interior cities to which the railway haulage will be no greater from the seaports than from the domestic mines, the whole question being that of railway freight rates.

It is true that considerable German railway coal reaches the interior of France as far as Lyons in this direction. The German imports assumed serious proportions during the French miners' strike of a year ago, when local coal could not be supplied and long contracts with foreigners were made, all of which have not yet expired. It is even probable that many of these contracts may be extended on terms which the French miners will find it impossible to underbid.

Since the general strike of 1902 and for the above reasons, the mining industry of the basin of the Loire (St. Etienne) has suffered a loss of not less than 20 per cent in production, while the Germans and the mines of the Departments of the Nord and Pas-de-Calais have gained that much of the trade formerly belonging to St. Etienne and the basin of the Loire.—Hilary S. Brunot, Consul at St. Etienne.

American Pork No Longer Prohibited in Turkey.—On April 20, 1881, the Sublime Porte issued a decree prohibiting, "in consequence of the existence of trichinæ in the salt pork imported from America," importation of this meat into the empire. A year later this measure of interdiction was extended to ham and lard of the same source. Minister Wallace observed in those days that in spite of the decree nearly nine-tenths of the salted meats consumed in Turkey would continue to be American under some foreign brand. While this prediction has proved correct to some extent, it is interesting to learn that the Turkish government, in reply to representations made in April, 1900, by Mr. Griscom, charge d'affairs, and in March, 1901, by Minister Leishman, has removed the prohibition against the importation of American pork products. Importations of this character must be accompanied by certificates from the sanitary authorities at the point of departure, authenticated by the Turkish consul, showing that the article has been microscopically examined and found clean. On arrival in a Turkish port the shipment will be examined again and admitted if found perfectly sound; otherwise it will be returned. In my report on this subject to the Department of State under date of February 2, 1900,* I stated that grocers here wanted American hams for this market. I would now recommend that exporters at home take advantage of the opening afforded. Correspondence should be addressed to Fadoul Ribeiz, George Komnos, or Najib Letayf, of Beirut; American Exchange Company, Haifa; Meshaka & Nachman, Damascus; John Hakim, Tripoli.—G. Bie Ravndal, Consul at Beirut.

American Products in St. Helena.—Consequent upon the rise in price of flour in South Australia (the source from which St. Helena draws its breadstuff and grain supplies), resulting from the recent severe drought, a considerable quantity of American flour is being imported by steamers via England, figuring under the head of imports from the United Kingdom; this also applies to kerosene, lumber, provisions, cattle feed, etc., which have their origin in the United States.

There is certainly an opening at St. Helena for at least two trading schooners a year, with assorted cargoes of American goods. The alleged drawback is the absence of return cargoes; yet many sailing vessels go to South and West Africa and on discharge of their cargoes proceed in ballast to the West Indies and South American ports and pick up cargoes for Europe and the United States.

A small cargo of cypress-pine lumber shipped at New Orleans for account of the St. Helena colonial government met a bare market, and double the quantity could easily have been placed at a good margin of profit.

For the information of the Navy Department, I would add that the present available supply of South Wales coal in private hands here is about 2,500 tons, quoted at 65s. ($15.82) per ton of 2,240 pounds delivered from lighters alongside at the rate of 200 to 250 tons per day.—Robert P. Pooley, Consul at St. Helena.

American vs. German Jewelry.—The Frankfurter Zeitung of July 11, 1903, contains an article on the relative merits of German and American jewelry and the necessity for closing German factories to American visitors. The article is dated Pforzheim, July 7, and states that while the United States is almost closed to the German jewelry industry on account of the high duty of 60 per cent *ad valorem*, North American competition has for years been trying, partly unsuccessfully, to meet German competition in exports to Central and South America, and that lately a North American jewelry company established a wholesale store in Germany which met with poor success on account of its American patterns; that it is now trying to acquire patterns of German articles. It is feared that the agents of the company will endeavor to gain access to the factories, under one pretext or another, as was done once before with reference to other specialties in order to learn the methods of work, without which the knowledge of the patterns is of little value. The Creditor Society, therefore, publicly gives warning in the local press against making foreign visitors acquainted with the methods of local factories without further investigation.—Richard Guenther, Consul-General, Frankfort.

Increased French Duty on American Meats.—An amendment to the French tariff law was passed by both houses of Parliament on July 3, whereby, among other changes of importance to American trade, salted meats—including pork, ham, and bacon—previously dutiable at the rate of 25 francs per 100 kilogrammes ($4.82 per 220 pounds) under both the general and minimum schedules, have been made dutiable at the rate of 50 francs ($9.65) under the general and 30 francs ($5.79) under the minimum schedule. The law has not yet been promulgated by the ministerial authorities. It is scarcely necessary to say that the application of a duty of 50 francs per 100 kilogrammes ($9.65 per 220 pounds) to meats imported from the United States will make it impossible to carry on this business. Inasmuch as goods from the United States are uniformly dutiable under the French general tariff (with the very few exceptions covered by the reciprocity treaty of 1898), it is probable that this general tariff will be applied in this case. Every important commercial nation, except the United States, obtains the benefit of the minimum tariff rates of France.—Robert P. Skinner, Consul-General, Marseilles.

Germany's Chemical Talent.—England and America have been the pioneers in inventing new processes in the manufacture of rubber goods and the development of this industry on a large scale, but the importance of Germany as a manufacturer of rubber goods is steadily increasing, and she is at present one of the foremost producers in this line. One of the factors that have contributed notably to the success of this industry in Germany has been the high grade of chemical talent which has been employed. While it is not possible to reproduce an article exactly from the results of chemical analysis, the results of German investigations show that important savings in the expense of testing and experimenting on a product which it is desired to imitate can be achieved by having this work done by men of large scientific knowledge who are thorough chemists. It is especially through the ability of these men that a development in the industry is to be looked for in this country.—Dean B. Mason, Vice and Deputy Consul-General at Berlin.

Commercial Items.—Cables.—According to press reports the Argentine government is about to order 50 tons of subterranean telegraph cable.

Photographic Articles.—German manufacturers of photographic articles are successfully exploiting the Chinese market, as amateur photography is becoming popular in China.

Persian Trade.—Russia is gradually crowding England out of the Persian markets. In 1889 the trade between England and her East Indian possessions and Persia aggregated $15,000,000; in 1899 it amounted to less than $10,000,000, while Russia's trade with Persia reached $22,000,000, a gain of 125 per cent since 1889. The imports of British textiles into Persia during the first eight months of 1902 were valued at $2,100,000, whereas in the same period of 1901 they were $3,500,000.—Simon W. Hanauer, Deputy Consul-General at Frankfort.

German Experts to Study Foreign Labor Conditions.—The Prussian Minister of Commerce, Herr Moeller, a few days ago addressed the Board of Trade at Osnabrück on the betterment of the handicraft and labor interests in Germany. Incidentally the minister stated that the government would send commissions of experts to Austria, England, Switzerland, and the United States for the purpose of studying the institutions and methods existing therein for the benefit of labor and trades. On the same occasion Herr Moeller advocated a governmental organization of chambers for trades and labor, and urged the establishment of trade schools where craftsmen may be enabled to obtain a semi-mercantile education, so as to acquire the skill of making correct estimates, economic calculations, etc.—Simon W. Hanauer, Deputy Consul-General at Frankfort.

Freight Discrimination on German Railways.—At a meeting of the board of directors of the Prussian State railroads, held on June 27, 1903, it was unanimously decided that from the 1st of July, 1903, a favorable freight rate—i. e., a 40 per cent reduction in the present rate—be made upon mine timber which is to be shipped from certain parts of Upper Silesia to foreign countries, via the German seaports located on the North and Baltic seas. The places from which shipments may be made upon such favorable terms are those located in the storm-bound districts of Upper Silesia.—Brainard H. Warner, Jr., Consul at Leipzig.

Japanese Coal for America.—According to the Kobé Herald of June 13, 1903, a demand for Japanese coal has arisen in America, through a strike in the British Columbia mines. Two British steamers lately sailed for San Francisco with coal from Karatsu and Moji. Though the freightage from Australia to America has risen by 2s. or 3s. (48 or 72 cents) per ton, a big amount of coal is being carried thence to America. When the strike ceases, there will be a fall in the demand for the Japanese coal.—Samuel S. Lyon, Consul at Kobé.

Beet-Sugar Area of Russia.—The German consul at Kief, writing in the Nachrichten für Handel und Industrie of July 11, 1903, says that according to returns made to the manufacturers of beet-root sugar in Russia the area planted in 1903 amounts to 513 528 dessiatines (1,386,525 acres), being 6.2 per cent less than in 1902. Of the 547,376 dessiatines (1,477,909 acres) planted in 1902, 22,505 dessiatines (60,763 acres) failed at seed time, leaving only 524,869 dessiatines (1,417,146 acres) to produce a crop.

* Printed in Consular Reports No. 237 (June, 1900), page 373.

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No. 1760, September 28.—Reports: Mineral Output of Russia—Mineral Production of Canada—Notes: Loom Shuttles in Northern France—Spanish Trade.

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No. 1763, October 1.—Agricultural Implements and Vehicles in Foreign Countries.

No. 1764, October 2.—Agricultural Implements and Vehicles in Foreign Countries.

No. 1765, October 3.—Reports: Calcareous Brick and Stone Manufacture in Germany—Notes: *English vs. American Coal—Brazilian Trade and Finances—Commodity Price Barometer—Iron and Coal in America and Germany—*Inheritances in France—Movement of Trade in the Kaiser Wilhelm Canal in 1902.

Other Reports can be obtained by applying to the Department of Commerce and Labor, Washington, D. C.

SELECTED FORMULÆ.

Handle Cement.—Resin, 12; sulphur flowers, 3; iron filings, 5. Melt together, fill the handle while hot, and insert the instrument.—Spatula.

Bleaching Bones.—Dip the bones for a few minutes in a boiling solution of one pound of caustic soda in one gallon of water; then rinse them thoroughly in water, rubbing them down with fine pumice stone, and expose them until whitened with the vapor of burning sulphur largely diluted with air, finally rinsing in warm water. Bones may also be whitened by exposure in a weak solution of javelle water.—Bull. of Pharm.

Black Aniline Varnish.—This is the recipe of a good varnish for metals, wood, and leather:

Aniline black	2 pounds
Gum lac	3 pounds
90 per cent spirit	45 pounds

Dissolve the aniline in as little as possible of a mixture of alcohol and concentrated acid. Then add to the alcoholic solution the gum lac.—Oils, Colours, and Drysalteries.

Bath Powder.—

Borax	4 ounces
Salicylic acid	1 drachm
Extract of cassia	1 drachm
Extract of jasmine	1 drachm
Oil of lavender	20 minims

Rub the oil and extracts with the borax and salicylic acid until the alcohol has evaporated. Use a heaping teaspoonful to the body bath.—Pharm. Era.

Cement for Metal Letters on Glass.—

Copal varnish	15 parts
Linseed oil varnish	5 parts
Raw turpentine	3 parts
Oil of turpentine	2 parts
Carpenter's glue, dissolved in water.	5 parts
Precipitated chalk	10 parts

—Pharm. Era.

The following formula has been contributed to the Bulletin of Pharmacy and is vouched for as being satisfactory:

Roach Powder.

Insect powder	1 pound
Powdered borax	5 pounds
Red precipitate	10 grains
Cudbear	10 grains
Carmine	10 grains

Mix.

An Excellent Permanent Paste.—

Wheat flour	1 pound
Water, cold	1 quart
Nitric acid	4 fl. drachms
Boric acid	40 grains
Oil of cloves	20 minims

Mix the flour, boric acid, and water, then strain the mixture; add the nitric acid, apply heat with constant stirring until the mixture thickens; when nearly cold add the oil of cloves. This paste will have a pleasant smell, will not attract flies and can be thinned by the addition of cold water as needed.—Pharm. Era.

Puts Pomades.—(1) Dried sodium carbonate, 1; tallow soap, 4; levigated emery, 25; water, 25. Heat on the water-bath and stir until smooth. (2) Jeweler's rouge, 1; petrolatum, 1; oil of mirbane, quantity sufficient to perfume. (3) Oil of turpentine, 1; finest levigated emery, 1; jeweler's rouge, 2; petrolatum, 2; oil of mirbane, quantity sufficient. Rub together. (4) Finest levigated emery, 5; jeweler's rouge, 5; mutton suet, 4; crude oleic acid, 4; perfume, quantity sufficient. Melt the suet and oleic acid together in the water-bath and remove from the fire. When cool, but still soft, add the powders and rub down until smooth. (5) Stearin, 8; mutton suet, 32; neat's foot oil, 2; jeweler's rouge, 20; precipitated chalk, 40. Proceed as in No. 4. (6) Finest levigated quartz sand, 2; jeweler's rouge, 3; petrolatum, 5. Mix. Instead of quartz sand levigated infusorial earth may be used.—Nat. Drug.

To Clean Very Soiled Hands.—A correspondent wants to know "how his hands, into the palms, and especially the front portions of the fingers of which the dirt has, as they say, become 'grinded,' can be cleaned." In such cases there are two or three methods of procedure. In the morning, wash in warm water, using a stiff brush, and apply glycerin. Apply two or three applications during the day, washing an hour or so afterward, again using the brush. Usually in the course of forty-eight hours, the hands are clean. Another plan is to apply a wash solution of liquor sodæ or potassæ, and wash in warm water, using a stiff brush, as before. Finally, wash the hands, rubbing them down with a bit of pumice, or infusorial earth. There are soaps made especially for this purpose, similar to those for use on wood work, etc., in which infusorial earth, or a similarly sharply comminuted matter is incorporated.—Nat. Drug.

Sticky Fly Paper.—The sticky material applied to the paper is the following:

Boiled linseed oil	5 to 7 parts
Gum thus	2 to 3 parts
Non-drying oil	3 to 7 parts

For the non-drying oil, cotton-seed, castor, or neatsfoot will answer—in fact, any of the cheaper oils that do not dry, or become hard will answer. The proper amount of each ingredient depends upon the condition of the boiled oil. If it is boiled down very stiff, more of the other ingredients will be necessary, while if thin, less will be required. Another formula is as follows:

Rosin	8 parts
Rapeseed oil	4 parts
Honey	1 part

Melt the rosin and oil together, and incorporate the honey. Two parts of raw linseed oil and 2 parts of honey may be used along with 8 parts of rosin instead of the foregoing. Use paper already sized, as it comes from the mills, for the material on which to spread the mixtures.—Nat. Drug.

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